CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

Bachelor thesis

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Case study of a patient with hemorrhagic stroke in cerebellum

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Dedication

I dedicate this bachelor thesis to my wonderful family in Saudi Arabia my father, my mother and my brothers for their great support from all views. I dedicate it to my upcoming baby who will give the brightness for my future and for my wife for her support during our staying in Czech Republic and the great moral support that she gave me. It is also dedicated to university staff who were cooperating with student in a nice manner and specially to my professors for all what they gave me during my study period.

Abstract

Physiotherapeutic case study of hemorrhagic stroke in the cerebellum with hemiplegia patient as bachelor thesis is provided for you to show the full kiensiological assessment, special therapy approaches and therapy effect during 9 sessions. The farther goal of this thesis is to explain the clinical picture, physiological, biomechanics points of view.

During my clinical practice, we used the main structure for the Kinesiological assessment according to the Prague School approaches. Manual muscle testing according to Kendall and Janda were used also. Due to the instructions and the protocols from the UVN hospital in Prague the main therapy concept was following " Grasies Concept" for stroke patients. Finally, we applied final kinesiological assessment to compare the patient situation before and after the therapy with focusing on the "Grasies Concept" effect.

As a result of our work we found that the "Gracies concept" shows a great result in spastic pattern prevention more on the lower extremity. However, significant improvement in patient stability and verticalization ability which influence the improvement in ADL scale results.

Keywords: Stroke, Hemorrhagic, Gracies, Approaches, PNF, DNS, Spasticity, Chronic State, Physiotherapy, Rehabilitation, Treatment

Declaration

I declare that I wrote my graduation dissertation (bachelor/graduate) independently, and that I have stated all the information sources and literature I used. Neither this thesis nor any substantial part of it have been submitted for the acquisition of another or the same academic degree.

In Prague, ….....

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Acknowledgements

It is an honour for me to have this opportunity to thank the persons whom guide me during this work starting by my supervisor Mgr. Kateřina Holubová who gave me a lot of her time, which I really appreciate it to instruct, guide and advise me to complete this work to be how it is now. Many thanks for Dis. Petr Smjkal for his guidance and advices during my clinical practice at UVN and his continues guidance during the writing of my thesis which I appreciate it. My thanks are also delivered to my grate Saudi Arabian government for giving me a scholarship, which allowed me to study abroad and for their financial support.

List of contents:

1. Introduction

This work, based on a case study of a hemorrhagic stroke patient in cerebellum combined with hemiplegia of his left body side which I selected this case to be my study case for the bachelor thesis due to its high frequency to have this diagnosis in Saudi Arabia and for my interests in neurological cases. General/theoretical part and special/Practical part are the main parts of my thesis.

The general part consists of a general explanation of the brain parts and its Anatomy, Neurophysiology of the brain, Stroke types and their Aetiology, Epidemiology, Hospitalization after having a stroke, Patients clinical picture, Biomechanics view in post-stroke stages and Physiotherapeutic approaches. The spatial part is counted as the main part of this work where it is including a kinesiological assessment (initial and final), Unit therapy using some Physiotherapeutic approaches which I obtained from the faculty during my study and according to the UVN hospital protocol of treating patients after stroke mainly using the “Gracie's Concept”, Conclusions of both initial and final examinations and the effect of the therapy.

The main goal of the therapy was to prevent the spastic pattern from forming higher level of function loss and disability to the patient, to restore functions that have been lost and to increase levels of patient independence during his activity of daily living.

My work was held at the UVN hospital in Prague 6 for two weeks from Monday the 4th of Jan 2016 to Friday the 15th of Jan 2015. I had 9 sessions with the patient who had an Intracerebral Hemorrhagic stroke. All sessions were supervised by Dis. Petr Smjekal.

2. Theoretical part

2.1 Brain and Cerebellum Anatomy

2.1.1 Brain Anatomy

The human body most important system is the nerve system due to its great functions. It is consists of the Central Nerve System and Peripheral Nerve System. As a result of their integration they can provide a wide range of controlling the body starting from receiving external or internal stimuli and ending by motoric response. The CNS includes the spinal cord and brain. The brain is counted as a mass of nerve tissues with great integration between them. It has three main regions Forebrain, Midbrain and Hindbrain (Brain, 2016).

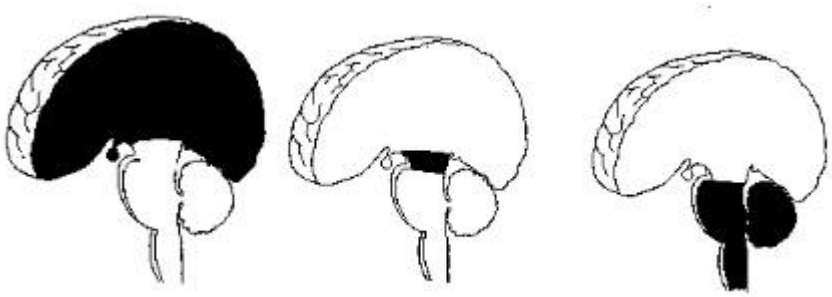

Figure 1: The Architecture of the Brain Forebrain, Midbrain and Hindbrain (Brain Basics: Know Your Brain, 2015).

The forebrain consists of the external structure Cerebrum and internal structures Hypothalamus, Thalamus and the limbic system. It has two hemispheres, right and left hemispheres. The thalamus located in between the medulla and the cerebrum. Hunger, thirst, body temperature, visceral functions and blood pressure are controlled by the hypothalamus, which also control the pituitary gland by producing hormones (Forebrain, 2016). Midbrain or mesencephalon which located in between the forebrain and the hindbrain is composed of tectum, which is responsible for visual and auditory control where is tegmentum responsible for coordination of sensorimotor information. The midbrain is relatively small compared to the forebrain and the hindbrain (Midbrain, 2016).

Medulla oblongata, Pons, and cerebellum are the component of the hindbrain or rhombencephalon. Midbrain and some parts of the hindbrain, Pons and medulla, are called the brainstem. Hindbrain components have different functions separately where is the medulla works mainly as a transmitter between the spinal cord and the brain, it is also autonomic function regulator such as respiration and heartbeat. The spinal cord and the brain connection is also function of the pons that works mainly as an information transmitter from the cerebrum to the cerebellum due the type of cells group that it contain which are part of the reticular formation controlling alertness, sleep, and wakefulness. a network of neurons extending throughout the brainstem that regulates. (Hindbrain, 2016) Finally, the cerebellum and its function (See chapter no. 2.2.2).

The part of the brain which occupied the most volume and weight around 66% of the brain total weight is the cerebrum. The cerebrum has two cerebral hemispheres and usually the left hemisphere is the dominant form function point of view. These hemispheres has an inner core made by myelinated nerve fibres called The white matter. On the other hand, The gray matter forming the outer cortex of the hemispheres. Basically, the cerebral cortex direct sensory impulses and motoric activities. Around 2,000 cm2 is the surface area of this important part of the brain which differ humen beings from other animals according to its extensive development. The cerebral has four lobes in each sides from the sagittal section perspective. Problems analysing, solving and motor functions are the responsibility of both frontal lobes were are parietal lobes responsible for sensation, handwriting and position of the body. The ability of hearing and memory are controlled by temporal lobes. The occipital lobes has the system of visual processing (Cerebrum, 2016).

The cerebral region has several ventricles which are interconnected. These ventricles are filled by cerebrospinal fluid located in the both lateral sides of cerebral hemispheres, central and caudal areas of the brain. By frontal section lateral ventricles are better to be observed with the basal ganglia located in their ventral surface, the corpus callosum in their posterior surface and the septum pellucidum, a sheet forming the midline sagittal surface of the cerebral hemispheres. A narrow pathway divided the left and right thalamus to the fourth ventricle which located in meulla and dorsal pons is the third ventricle. The spinal cord central canal is formed from the fourth ventricle. However, no function of all ventricles was found up to now (Purves, D., Augustine, G.

J., Fitzpatrick, D., Katz, L. C., Lamantia, A. S., McNamara, J. O., & Williams, S. M, 2001).

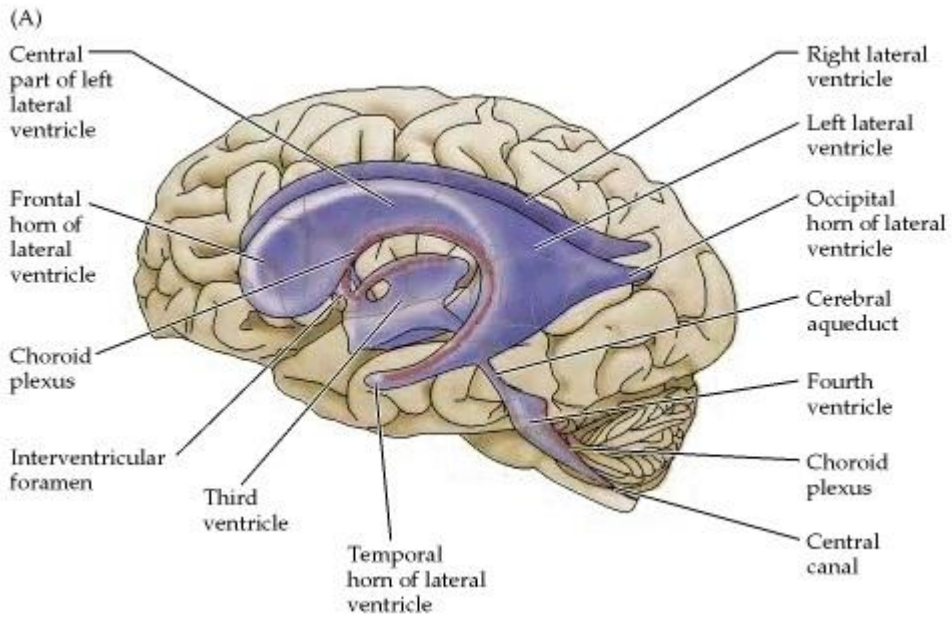

Figure 2: The ventricular system of the human brain (Purves, D., Augustine, G. J., Fitzpatrick, D., Katz, L. C., Lamantia, A. S., McNamara, J. O., & Williams, S. M., 2001).

Two arteries supply the brain internal and vertebral arteries. Most of the cerebrum is innervated by internal carotid arteries where is the caudal part, cerebellum and brainstem is innervated by the vertebral arteries. Left and right vertebral arteries passes the skull then they form together the basilar artery which meet the internal carotid arteries in the Circle of Willis. The Circle of Willis is counted as a safety feature which prevent the damage of the brain if blockage acuure in major vessels. As air sinuses in the face and nasal sinuses the brain has also a sinuses which felled by blood. The upper and lower sagittal sinuses and the cavernous sinuses drain the cerebrum and the anterior base of skull, respectively. Finally, all sinuses are connected to the sigmoid sinuses then the blood travel through skull in the two jugular veins. (Tonya, H., 2013).

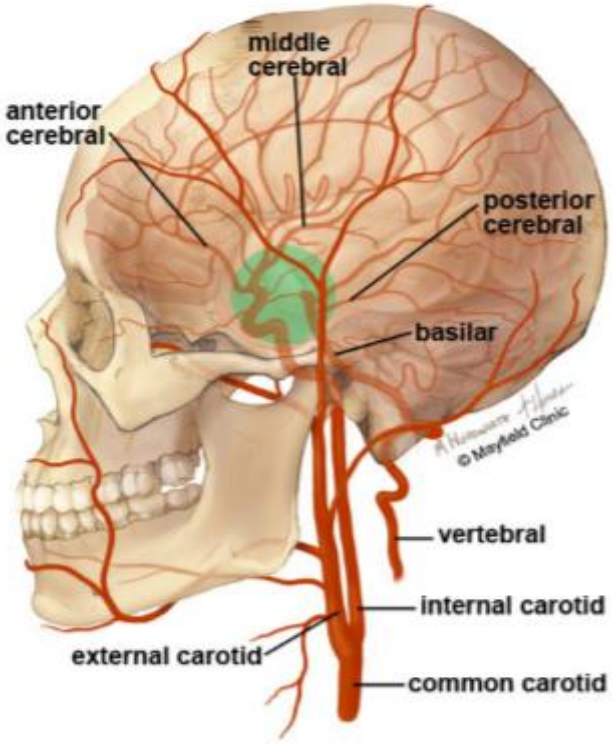

Figure 3: Brain blood supply (Tonya, H., 2013).

2.1.2 Cerebellum Anatomy

Cerebellum, located at the posterior side of the brain inferior to the occipital and temporal lobes. It has two main parts the cerebellar deep nuclei and cerebellar cortex, which cover the cerebellar deep nuclei. Cerebellar cortex characterized by foldes and fissures through a cross section. Fissures are located in mediolaterally dividing the cerebellar cortex into three lobes an anterior lobe, flocculonodular lobe and posterior lobe. When sagittal setion is applied the cerebellum can be devided in to three zones inner zone (The vermis), intermediate zones and lateral zones (lateral hemispheres). From morphological point of view, there are no borders between last two zones (James, K., 2016).

2.2 Neurophysiology of Brain and Cerebellum

2.2.1 Neurophysiology of Brain

The nervous system is composed of cells that receives and sends information which connect brain to the whole body parts. These cells called neurons and they have various shapes and sizes. Neurons has three main parts dendrites as input part, cell body and axon as output part. The human brain contain around 100000 million neurons. However, neurons could have different body part according to their location in the body for instance in dorsal root ganglion cells have no dendrites where in the brain cells axons are missing. The connection mechanism between neurons starts by receiving a message through the dendrites in a chemical signal form which called neurotransmitters. Then, dendrites convert the a chemical signal to an electric current which runs through the cell body to the end of the axon where its convert back to chemical signal. After that, the neurotransmitters travel to other neuron dendrites passing a small gap called synapse (Neurons 'Nerve Cells', 2016). Axons are usually covered with myelin sheet, a lipid substance which works as an electrical insulator to increase the action potentials conduction. This sheet is formed by Schwann cells (Carpenter, R., & Reddi, B., 2012). In the cell body water aqupied around 75%. Proteins and lipids has the other 25% of whole body cell. As dendrites work as receptor of the weak electric current (impulses) they have the ability to receive thousands of neurons (Tonya, H, 2013).

2.2.2 Neurophysiology of Cerebellum

The "little brain" term refers to the part of brain, This part of brain has around the half number of neurons in the brain although it has around 10% of brain total volume. In past, scientist believed that cerebellum is the main motor structure due to the motor functions impairment when it is damaged. Nowadays, researches shows that cerebellum functions are maintaining posture and balance of human body, voluntary movement coordination, motor learning and controlling some cognitive functions such as language. Maintaining posture and balance of the human body are controlled by receiving information from Proprioceptors and vestibular receptors. And by modulating orders to neurons which responsible for motor system the cerebellum control the body

position. Cerebellum damage from this point of view leads to bad stereotype of posture as wide-base of support. Moreover, Voluntary movement coordination of different groups of muscles is done by time and force coordination in cerebellum. Fine-tuning motor programs adaptation in cerebellum play a role in controlling motor learning. Cerebellum functions are still not fully understood where now it gose across the barier that says it is only for motor control (James, K., 2016) (cerebellum, 2016).

However, In case of lesion in cerebellum sensory and motor systems in the ipsilateral side of the body is affected. The effect is different due to the location of lesion in cerebellum, when spinocerebellum is damaged controlling of movement in walking will be difficult and it is combined with slight shuffling movements which made the base of gait wide in addition to that movements of arm and hand are impaired and dysdiadochokinesia which present the difficulty to perform fast alternating movements may present. Generally, this type of lesion effect coordination of muscles in movements. On the other hand, vestibulocerebellum damage upright standing ability and patient may develop nystagmus which is the disability to fix the eye on a moving object. Hypo-tone of muscles can occur due to the vestibular nuclei pathways disruption. Finally, cerebrocerebellum lesions sequences are learning activates which needs high skills (Purves, D., Augustine, G. J., Fitzpatrick, D., Katz, L. C., Lamantia, A. S., McNamara, J. O., & Williams, S. M, 2001).

2.3 Stroke

2.3.1 Definition and Epidemiology of stroke

Strokes or cerebrovascular accident is a significant decrease of blood in the brain due to interruption in the blood flow which leads to cell death. This situation causes different impairments according to the area in the brain that have been damaged. There are two types of decreased blood flow in brain an ischemic stroke and a hemorrhagic stroke (Berry, S. R., Wilson, B. P., & Fallon, L. M., 2014). Blockage in blood vessels occurs due to various reasons as moving blood clot, static clot or arterial dissection can cause an ischemic stroke. On the other hand, a hemorrhagic stroke is occur when blood exit from a broken vessel due to a burst in the vessel. This cause a

reduction in the blood being transfer to the brain and can cause increase in brain pressure. Cerebellar hemorrhagic is one type of intra-axial haemorrhage types which together with extra-axial haemorrhage are the main types of intracranial hemorrhagic stroke. (Rebecca, J., Stahl, M., 2015).

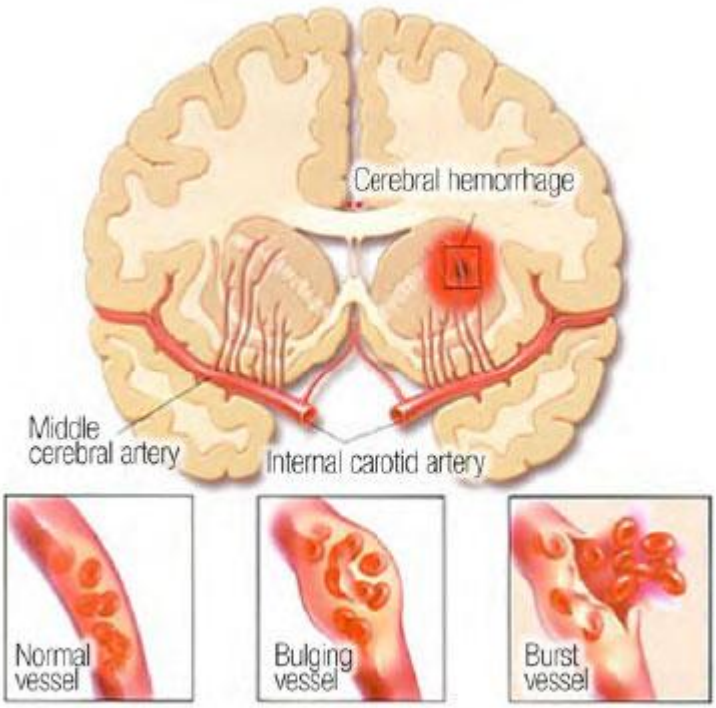

Figure 4: Hemorrhagic stroke (Strizhak, A., 2014).

One reason as to why stroke is one of the most feared diseases is due to its high disability as well as high morbidity rates now common as a result of decreased mortality rates. According to recent research studies oriented literature, 70% to 85% of strokes suffered are ischemic in nature, 10% to 20% attributable to hemorrhage while the other remainders are undefined (Khoury, Kissela, Sucharew, Alwell, Moomaw, Woo... & Broderick, 2013). Hemorrhagic stroke is characterized by core risk factors like excessive alcohol consumption and hypertension. Another significant risk factor is smoking with projects an overall associated risk of about 3.5 for stroke. Women smokers are highly like to suffer subarachnoid hemorrhage with associated doze response associations (Khoury et al., 2013). Excessive alcohol consumption has been proven to appraise the risk of suffering from stroke, though there is no sufficient evidence regarding light or moderate alcohol consumption. For ischemic stroke, the risk

factors are such that family history is a significant attribute. Other stroke-related risk factors include oral contraceptives, high cholesterol, valvular disorders, atrial fibrillation, diabetes mellitus, hyperlipidemia, hypertension, smoking, age and coagulation disorders (Khoury et al., 2013). Hypertension is the most dominant risk factor with an RR of 4.0 with age being another substantial risk factor with an RR of 1.6 (Khoury et al., 2013). Diabetes mellitus also increases the risk factor of an individual suffering from a stroke (Zhang, Chapman, Plested, Jackson & Purroy, 2012). As such, it is now not regarded to as an untreatable and unavoidable disease, but an emergency that with the help of specialized paramedic teams can lower post-stroke treatment costs as well as improve subsequent outcomes.

As much as the public generally regards stroke as an expression of a cerebrovascular illness leading to nonconclusive, abrupt and more so, critical neurological deficit (Zhang et al., 2012). There are two groups used to classify stroke. The most common being ischemic stroke also referred to as cerebral infarction and cardioembolic stroke or those stemming from cardiac complications. An ischemic stroke is largely caused by intracranial parenchymatous hemorrhage as a result of atherothrombosis affecting the aortic arch and the extracranial arteries (Zhang et al., 2012). The most prevalent causes of intracardiac thrombus include atrial fibrillation or myocardial infarction. Valvular disease is also closely associated with stroke, especially where individuals have defective native valves or prosthetic valves.

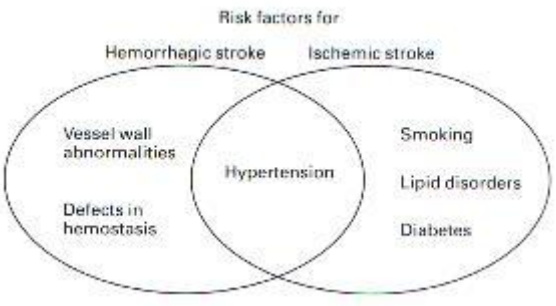

Figure 5: A depiction of risk factors leading to the two main forms of stroke (Epidemiology of Stroke, 2016).

There are numerous risk factors leading to incidences of stroke and as such as categorized as potentially modifiable, modifiable and non-modifiable (Zhang et al.,

2012). The non-modifiable risks factors are vitally important for practitioners to be able to detect early as the failure to take corrective measures increases risk levels. It is thus critical that non-modifiable factors are subjected to comprehensive treatment regimes towards reducing such to a lower risk factor status such as modifiable risk factors (Zhang et al., 2012). Examples of non-modifiable risk factors include gender, age, family history and race or ethnicity. Age is the most significant risk factor such that for an individual above the age of 55, the strake rate multiplies by two every ten years regardless of other risk factors.

Modifiable risk factors include hypertension which is considered as contributing to the highest risk of suffering stroke. As such, it is a condition prevalent in about 70 of all reported stroke cases (Khoury et al., 2013). Stroke risks increase as blood pressure increases regardless of gender. Cigarette smoking is also considered as one major risk factor associated with hemorrhagic and ischemic stroke (Go, Mozaffarian, Roger, Benjamin, Berry, Blaha... & Fullerton, 2014). As such, the more cigarettes an individual consumes in a day, the greater the risk of stroke and as such, is higher for the female gender (Khoury et al., 2013). Diabetes is another potent risk factor for stroke though it increases more risk in women as compared to men. Other identifiable modifiable risk factors include hypercholesterolemia though their association with increasing risk decreases with age (Khoury et al., 2013).

Primary prevention aims at anticipating any major adverse situation relating to health. It is universally embraced that the risk of an individual suffering stroke is founded on lifestyle (Khoury et al., 2013). The best avenue for preventing stroke in society is through population education. This is seen as the most appropriate means with which to curb risk factor development. As such, positive lifestyle changes are the starting point to stroke prevention and as such, the population should desist from poor dietary habits, smoking, alcohol consumption and inadequate physical activity (Khoury et al., 2013). Straightforward recommendations should be accorded to population relative to healthy weight loss, decreasing the intake of animal fat and excessive salt intakes, increased physical fitness regimes, cessation from alcohol consumption and smoking (Go et al., 2014). Secondly, population education should encourage greater involvement from an individual standpoint which can allow for better hypertension detection, atrial fibrillation, and diabetes mellitus in an effort to acquire suitable treatment outcomes (Khoury et al., 2013).

Secondary prevention of stroke involves addressing issues encountered by individuals or patients at the risk of suffering stroke or more specifically, transient ischemic attacks (Go et al., 2014). Drugs like ticlopidine, aspirin, dipyridamole as well as clopidogrel have been found to be especially efficacious towards the reduction of stroke incidences (Khoury et al., 2013). Similarly, anticoagulants to manage atrial fibrillation potent within a therapeutic range of about INR 2-3 has been found to be efficient especially in instances where intracerebral hemorrhage levels are lower than 1% per annum (Khoury et al., 2013). Carotid endarterectomy has also been found to be evidently beneficial to individuals who have recently suffered a transient ischemic stroke, non-disabling stroke, as well as ipsilateral high-grade stenosis relevant to the inner carotid artery (Khoury et al., 2013).

Tertiary prevention relates to inpatient rehabilitation treatment regimes after one has already suffered from a stroke episode (Go et al., 2014). This is carried out with the sole aim of enabling survivors to either recover partially or gain total independence from patient care and lead enhanced qualities of life. It is important to point out that stroke recovery in most cases never becomes complete and as such, about 40% of stroke survivors acquiring care while at home require assistance to continue with day-to-day activities (Go et al., 2014).

2.3.2 Clinical picture

A stroke could be diagnosed using CT or MRI devises. The CT is a radiological technique which shows a three-dimensional scaning picture where is MRI is based on nonradiological technique which provides a special three-dimensional photes. Not like the CT using MRI could help to diagnose the stroke in earlier stages.

Stroke patients have different symptoms due to the location of the lesion in the brain. High number of patients daignosed with stroke have the symptoms for two to three days. Here are some general symptoms which could be present on the stroke patients: Speech disorders as aphasia which is the disability to speak, dysarthria which is speaking difficulty, hemiplegia or hemiparesis which refare to numbness or weakness in one side of the body, Visual problems or disability to move or control movement of one eye (rarly both eyes) in specific direction which called as amaurosis fugax, severe headaches, vertigo, dizziness, unexpected falls, vomiting, un-coordination

of trunk or limbs movements, tremors, decreasing in sensation ability to heat or pain and hearing difficulties. Patients could fall into a coma, but this symptom is rare (Rebecca, J., Stahl, M., 2015) (Berry, S. R., Wilson, B. P., & Fallon, L. M., 2014).

Moreover, there are some specific symptoms in the time of having stroke which could help to daignise the patint with hemorrhagic stroke where some of patients start to have severe headache and may vomit. Other symptoms they could have are:

- Truncal ataxia.
- Vertigo.
- Dysarthria
- Pain in nuchal area.
- Consciousness changing or even coma.

Some symptoms can be observed during the physical examinations, if the patint was not in a coma and he was fully cooperating in the examinations, like

- Sings of cerebellar lateralizing such as:
  - Limb ataxia
  - High reflexes.
  - Nuchal rigidity
  - Nystagmus
  - Weakness of facial muscles.
- Difficulty in Gait.
- Cardiopulmonary complications

If patient was not cooperative with the examiner we can see some of the following symptoms:

- Respirations rhythm is not regular.
- Extensor plantar responses
- Abnormal movement of eyes.

- No corneal and pipillary responses or low responses are present. (Stephen, H., Helmi, L., 2014).

After having a stroke patients could experience some of post-stroke conditions such as pain, urine incontinence, fatigue, dysphagia, seizures or epilepsy, paralysis, hemiparesis, foot drop, spasticity, vision problems (Post-Stroke Conditions, 2016). Spasticity start to appear after with low intensity after month and after 3 months patient will have full spastic pattern (Sommerfeld, D. K., Eek, E. U. B., Svensson, A. K., Holmqvist, L. W., & von Arbin, M. H., 2004).

2.3.3 Spasticity, PNF and Gracies concept

Spasticity is one of the symptoms of brain lesions as Cerebral palsy, multiple sclerosis, traumatic brain injuries and stroke. It comes as a physiological result after the damage in the brain. Not only stroke patient or patients with brain injury have the spasticity, but also patients with spinal cord injuries. Spasticity has a special characteristic which is velocity-dependent to passive stretch as Lance's define it "A motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyper-excitability of the stretch reflex, as one component of the upper motoneuron syndrome" (Bandi, S., & Ward, A. B., 2010) and it may appear in the period form first few days to around 6 weeks from the stroke time (Thibaut, A., Chatelle, C., Ziegler, E., Bruno, M. A., Laureys, S., & Gosseries, O., 2013). As all symptoms of stroke, spasticity is depends on the time, size and place of the stroke. It could be classified as follow according to anatomical point of view:

- Quadriparesis/tetraplegia: all four extremities
- Paraparesis/diplegia: bilateral lower extremities
- Hemiparesis: ipsilateral upper and lower extremities
- Monoparesis: one extremity
- Truncal/cervical: axial, postural, or neck muscles

Patients with spasticity have antigravity postural patterns. Patients will have adduction of shoulder joint, flexion of elbow and ulnar flexion of wrist joint, adduction

of hip joint, extension of knee joint and plantar flexion of ankle joint with inversion of foot (Patel, A. T., 2010).

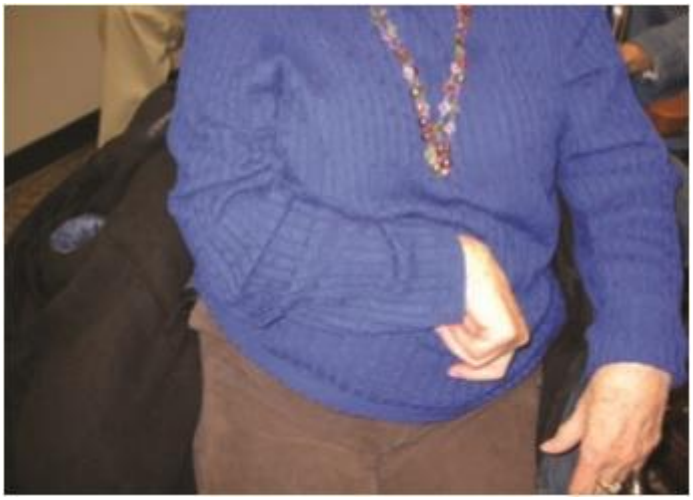

Figure 6: Shoulder Adducted, Elbow, Wrist and Fingers Flexed, and Forearm Pronated (Patel, A. T., 2010).

Latest statistics in 2015 shows that range of patients with spasticity developed by stroke are 15% to 40% of all stroke patients. (Michael, R. L., Samuel R. B., 2015). From pathophysiological analysis of spasticity, Spasticity result from disinhibition of reflexes of spine due to upper motor neuron lesion. Flexors, Extensors and stretch are the spinal reflexes that controlled by supraspinal through the inhibition and excitation pathways.

To test the therapy effect of spasticity treatment it necessary to measure the spasticity. There are many methods or scales that measure the spasticity. Tardieu Scale and Ashworth Scale. Most known one and used in this thesis is Ashworth Scale . It is done by fast stretch of spastic muscle then feel and measure the resistance. This scale has five grades starting by grade “0” with no increase in muscle tone. Later, Bohannon and Smith in 1987 added one more grade which is “ 1+“ that explain “Slight increase in tone giving a catch, release and minimal resistance throughout the remainder (less than half) of ROM” after their clinical practice with stroke patient.

It important to treat spasticity due to the complications that may occur, such as pain, contractures and shortening of muscles, subluxation or deformity of joints, function loss, pressure sores, psychological problems. Spasticity could be treated by

many ways surgical and non surgical treatments. The non surgical treatments including pharmacological and theraputical treatments. Baclofen, Dantrolene Sodium, Benzodiazepines, Tizanidine and Gabapentin are oral medications that could used to treat spasticity where are other pharmacological treatments used as injections (Bandi, S., & Ward, A. B., 2010). Many approaches in physiotherapy are used to decrease spasticity PNF and Gracies approach are most known and effective approaches.

PNF or Proprioceptive Neuromuscular Facilitation was found by the physician and neurologist Herman Kabat who used proprioceptive techniques on neurological patients but mainly on young patients diagnosed with cerebral palsy in 40's. He developed the PNF technique after he found that proximal segments stimulation by stimulating the distal segments. His technique was based on "Sherrington's principles of irradiation, reciprocal innervation and inhibition". PNF has two uses strengthening and stretching techniques where is the stretching techniques are used to effect spasticity (Lee, B., Heidi B., 2013).

Gracies concept or approach is an approach which used in spastic paresis. He refers paralysis, muscle shortening and muscle over-activity as the main factors of disabling in spastic patients. In central lesions, muscle shortening and muscle over-activity are combined. From this principle he developed a therapeutical technique which include motor training, stretch, and local partial blocks as the main bases for any recovery of functional abilities. Mainly, this technique depends on strengthening agonist and reduce the activity of antagonist in combination with stretching. Moreover, it could be described as self-rehabilitation program (Gracies, J. M., 2001) (Gracies, J. M., 2015) (Ward, A., Jost, W., Jech, R., Gracies, J. M., 2016).

2.3.4 Biomechanics of Stroke: In Effected Joints by Spasticity and in Gait

Millions of individuals in the US and other developed nations suffer from stroke-induced disabilities with more than 700,000 cases occurring for the first time annually (Singer, Kobayashi, Lincoln, Orendurff & Foreman, 2014). Given that re-establishing walking abilities after stroke is critical to independence, improving on a survivor's walking function is perceived as the most important attribute towards physiotherapy regimes. As such, understanding the under workings the functionality of

individual muscles during gait is critical towards formulating the most suitable and adequate medical care interventions for post-stroke patients (Singer et al., 2014).

There are a number of challenges associated with re-establishing the gait function in post-stroke patients. One of the most common is associated with muscle weakness and spasticity in paretic limbs, in this particular case, the leg joints (Singer et al., 2014). The velocity independent gain in muscle tone or spasticity in most cases impacts on the plantar flexor and quadriceps muscles. In the swing stage, the muscles tend to generate over sufficient knee forces and moments such that they hinder the joint attaining sufficient peak flexion resulting in the stiff knee gait condition (Singer et al., 2014). It is common to find that muscle weakness is common in distal locations of the leg like the ankle such that inabilities to dorsiflex a survivors foot in the swing stage results in foot drop, thereby impeding the swing limb's clearance (Singer et al., 2014).

A hemiparetic gait is often characterized by slowed speed in gait as well as asymmetric kinematics and intra and inter-subject variability (Singer et al., 2014). The result is reduced hip excursions due to the slowed speed as well as substantially diminished step lengths. Research studies are still seeking to figure out whether a greater hip extension can serve to enhance paretic muscle potentials towards gaining greater knee flexion when in the swing phase (Leung, Smith, Harvey, Moseley & Chapparo, 2014).

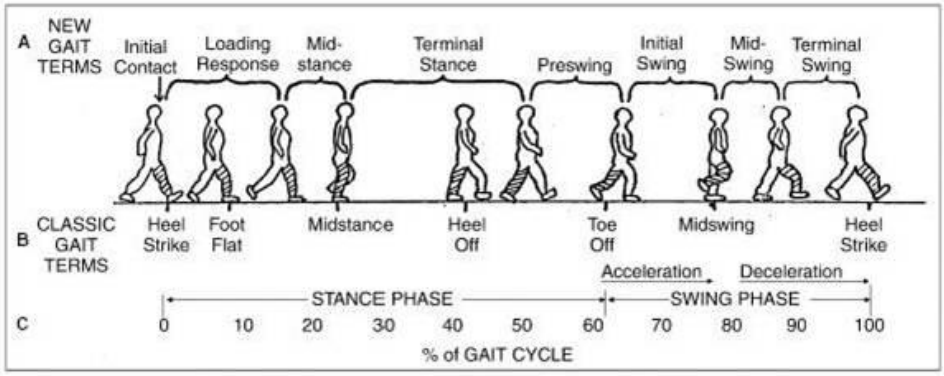

Figure 7: Gait Cycle (Cuccurullo, S. J., 2014).

While in gait, the position of the limb determines how muscle moments function and more so, the impacts each muscle set has on a survivor's body (Leung et al., 2014). Presently, computer simulations are aiding medical students as well as scholars to critically study muscle functions at the individual level (Leung et al., 2014).

For instance, it is now possible to assess induced acceleration through analytical tools which not only identify but also quantify the inputs of individual muscle sets to segment and joint accelerations.

Among the vast stroke populations in developed nations, it is common to witness significant variations concerning limb positions and by extension, muscle strength relative to the healthy populace (Leung et al., 2014). A number of research studies indicate that spatial as well as the temporal features associated with hemiparetic gait manifest significant alterations in comparison to otherwise healthy controls.

Self-selected or preferred gait speed exhibited by survivors tends to range from about 0.18t to 1.03 meters per second (Chisholm, Perry & McIlroy, 2013). This is, however, dependent on the severity of disability while among healthy populations, this averages at approximately 1.4 meters per second. The stance and swing times, which determine temporal asymmetry are seen to be more common relative to spatial asymmetry and as such, correlate to lessened support time for the paretic limb to get back to the double support phase which is considerably stable (Chisholm, Perry & McIlroy, 2013). Among stroke patients, it is common to find that they manifest step length asymmetry especially for those with severe temporal asymmetry, and more so, this tends to be dependent on the direction. The step width is also considerably greater in comparison to healthy individuals at harmonized walking velocities in an effort to compensate for the predominantly weak balance control (Chisholm, Perry & McIlroy, 2013). Among stroke patients manifesting severe temporal asymmetry, it is common to witness slowed gait speeds as well as heightened motor impairments in the lower limb. In comparison to healthy walking controls at harmonized slowed speeds, stroke survivors tend to show longer durations expended in the stance stage for both legs (Chisholm, Perry & McIlroy, 2013). As such, temporal-spatial symmetry and gait speed are important indicators for the locomotors function towards monitoring gait performance as well as making evaluations that impact on rehabilitation strategies.

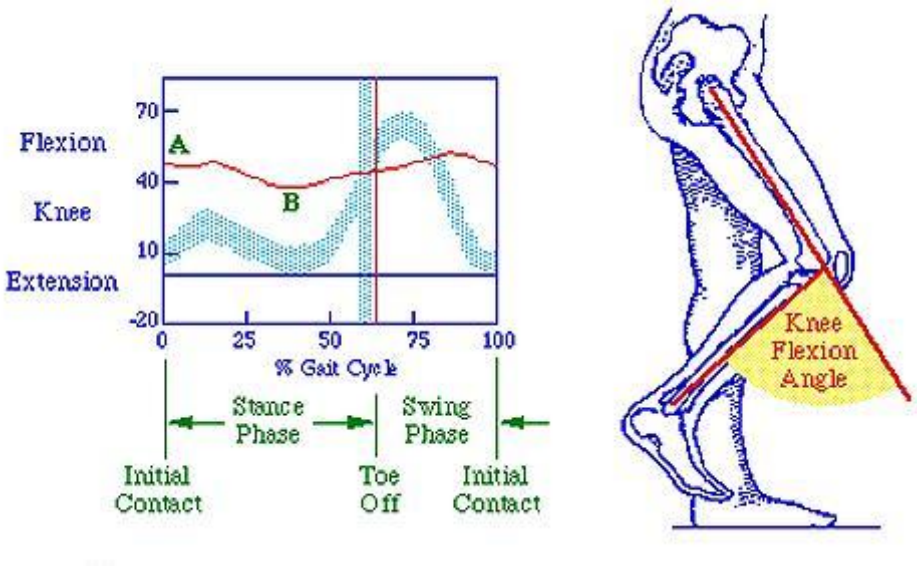

Figure 8: Image depicting kinematic assessment of forces and moments (Davis, D. B., Õunpuu, S., DeLuca, P. A., & Romness, M. J., 1999).

Among healthy populations, the degree of joint movement functions for the sagittal plane is found to positively correlate with gait speed (Chisholm, Perry & McIlroy, 2013). On the other hand, stroke victims walking at slowed velocities manifest lower sagittal peak joint movements concerning both lower parts of the legs (Leung et al., 2014). Other kinematic deviations relative to hemiparetic gait offer insights as to underlying impairments as well as compensatory strategies that cannot be attributable to slowed walking speeds. The distinctive features of a paretic side tend to also include heightened ankle plantarflexion upon making initial contact, reduced hip extension at the point of toe off, knee hyperextension during the mid-stance stage, lesser knee flexion as well as ankle dorsiflexion in the swing stage (Leung et al., 2014). For the frontal plane, there are a number of deviations which result in greater pelvic hiking, ankle inversion as well as hip abduction noticeable during the paretic limb's swing phase. The evident kinematic deviations tend to be in tandem with two major impairments associated with the paretic side. The first one is difficulties associated with initiating the swing phase as well as forward propulsion (Leung et al., 2014). The second one being, weak balance control for the single limb. Substantial degrees of variation relative to the kinematic profiles of the lower limb joint are visible across individuals with stroke as well as varying kinetic strategies for acquiring related movement outcomes.

Kinematic assessments of forces, as well as moments created within lower limb joints, offer significant information towards comprehending the patterns of movement outcomes (Chisholm, Perry & McIlroy, 2013). Normally, the degree of power profiles and moments in the lower limb are lower concerning the paretic side in comparison to the other side referred to as the nonparetic side, as it manifests healthy controls. The profiles of the joint kinetic in sagittal plane remain highly relative to functional capacity and walking speed. Particularly slow walkers tend to manifest lesser power dedicated to hip flexors at the pull off stage, ankle plantarflexors in the push off stage as well as the knee extensors relative to the swing stage (Chisholm, Perry & McIlroy, 2013). The cost of mechanical energy will definitely continue to rise as the trunk is lifted in the swing stage as a result of the paretic limb's pelvic hiking aimed at compensating for lesser knee flexion. On the other hand, greater propulsion is evident in the limb that is non paretic due to more kinetic energy being dispensed off at the toe off stage in an effort to cut back on time expended in supporting the single limb on the paretic side (Chisholm, Perry & McIlroy, 2013). This is consistent with the low degree posterior, anterior reaction forces on the ground during the push off stage on the side that is paretic. As such, the biomechanics of stroke survivors with respect to gait and spasticity of knee joints is characterized by greater power bursts that are profoundly positive (Chisholm, Perry & McIlroy, 2013). This is an effort to compensate for the early stance movement about hip extensors as well as the pre-swing paretic hip flexors.

2.3.5 Treatment

There are a number of treatment regimes available for individuals who have survived stroke incidences. Given that spasticity is the most prevalent condition survivors have to grapple with, an assortment of strategies are available for spasticity management (Wright, Hill, Bernhardt, Lindley, Ada, Bajorek... & Hersh, 2012). It is important to point out that numerous publications relate to the treatment of stroke survivors with distinct functional objectives such as enhancing gait, ease of care and suppressing noxious stimuli (Wright et al., 2012).

2.3.5.1 Pharmacotherapy

For individuals aware of signs and symptoms associated with stroke, more specifically, ischemic stroke, healthcare practitioners can offer a range of pharmacological treatments depending on the state of severity (Wright et al., 2012). Given that this is a case of emergency treatment, a clot-busting type of drug referred to as a thrombolytic is administered. The pharmacological effects of the drug are such that it disintegrates the clots via a tissue plasminogen activator or tPA, a thrombolytic. tPA enhances a patient's odds of stroke recovery (Wright et al., 2012). Research studies indicate that patients suffering from ischemic stroke and are administered with tPA have a high probability of full recovering from such an incident in comparison to those who do not receive the drug during emergency treatment (Wright et al., 2012). Similarly, patients administered with tPA are less likely to need some form of long-term health care or nursing home care. It is, however, critical that that a stroke patient is offered such treatment in the shortest time possible after the occurrence of a stroke incident so that the treatment can be effective (Wright et al., 2012).

2.3.5.2 Surgical Treatment

There are also a number of other treatment alternatives for individuals who have suffered stroke (Wright et al., 2012). These treatments enable surgeons and healthcare professionals to arrest situations where patients are suffering from some form of hemorrhage and as such save tissues in the brain from extensive and irreversible damage (Wright et al., 2012). One such treatment is referred to as an endovascular procedure and is used in the treatment of particular hemorrhagic strokes (Wright et al., 2012). They are preferred by some practitioners as they are not overly invasive and less likely to result in fatalities. This procedure involves a physician intricately inserting an elongated tube into some major artery either in the leg or arm. The doctor then works to guide this tube to parts where a weak spot or otherwise a broken blood vessel has been pin pointed (Wright et al., 2012). The tube is then used in the installation of a device similar to a coil which prevents further bleeding or repairs the damaged vessel.

Surgery as a treatment intervention for stroke is necessary where cerebral oedema is detected (Wright et al., 2012). Cerebral oedema occurring in the peri lesional or infracted brain tissue quickly leads to unprecedented deterioration and death.

Hemicraniectomy is a form of surgical procedure recommended for victims of ischaemic stroke especially where it is deemed as largely life threatening (Wright et al., 2012). The procedure is also critical towards enabling patient to relive suffering or even death from space occupying forms of cerebral oedema, such as where the middle cerebral artery is affected. Decompressive hemicraniectomy is the most potent treatment for ischemic stroke patients who suffer brain hemorrhage (Wright et al., 2012).

2.3.5.3 Occupational therapy and Physiotherapy

Stroke rehabilitation enables survivors to recover from such traumatic incidences. Through rehabilitation, which is a form of occupational therapy, patients are able to systematically regain speech, locomotion and other physical functionalities (Wright et al., 2012). It is important to point out that occupational therapy is accorded after stroke has been medically contained and stabilized. It includes physical therapy, speech therapy as well as occupational therapy. Physical therapy regimes are formulated to enable stroke survivors re-establish locomotion, a balanced gait as well as coordination of other bodily activities like lying down, sitting, walking, and other transitional movements like moving from a chair onto a bed (Wright et al., 2012). Spasticity is also a task of physiotherapist as it is discussed previously (see chapter 2.3.3). Occupational therapy regimes are formulated to enable survivors re-establish independence in carrying out normal day-to-day activities like grooming, eating, toileting, dressing and bathing. Occupational Therapists place a lot of emphasis on enhancing fine motor skills as well as upper extremity movements to enable survivors to carry out essential self-care activities. Speech therapy is prescribed to stroke survivors to assist them to improve on speaking skills and language, swallowing as well as other cognitive capabilities (Wright et al., 2012). Appropriate stroke treatment regimes are imperative for survivors to realize the most favorable treatment outcomes.

2.3.6 Prognosis of stroke patients

The stroke patient prognosis is important towards enabling survivors positively embrace long-term survival, subsequent recovery and rehabilitation (Kernan, Ovbiagele, Black, Bravata, Chimowitz, Ezekowitz... & Johnston, 2014). As such, this offers vital tips to ensure appropriate care is accorded to stroke patients and more so,

enable care givers to comprehend the most appropriate means to offer care and more so, cope with stresses associated with offering care in the home setting.

The ASA or American Stroke Association provides that it is one of the major causes of fatalities in the US with the disease affecting women more than it does men (Kernan et al., 2014). However, mortality rates associated with stroke have fallen significantly in the past two decades to approximately 40 new cases per 100,000 victims in the year 2010. Research studies also indicate that up to 75% of victims tend to survive the initial stroke in the first year. (Kernan et al., 2014) It is also more pronounced among America's elderly populations with over 65% of hospitalization cases being citizens with over 65 years of age. With time, a good number of survivors are able to one again re-establish full independence though about 25% remain with some minor disability while about 40% are reported to exhibit moderate to relentless disabilities (Kernan et al., 2014). It thus imperative to list stroke survivors on score charts in an effort to enable them quickly predict and subsequently establish the severity of symptoms experienced. It is, however, important to critically point out that known warning signs often occur with little warning whether as symptoms or signs and sometime manifested a few minutes before an actual stroke occurs.

The initial signs of an impending stroke include severe headaches, lack of physical coordination, communication difficulties, and abrupt vision challenges in either, both eyes or a single eye (Kernan et al., 2014). Numbing sensations in the limbs and face, especially on side, are an early warning sign of stroke. If such symptoms are noticed in a person who has had a history of suffering from stroke or is associated with known risk factors, it is critical that medical attention is accorded by professional emergency teams in the shortest time possible (Kernan et al., 2014). Given that women suffer more from stroke in comparison to men, it is critical to understand the symptoms common in women as well as those common in men. Women often show signs of stroke as abruptly occurring hiccups, general feelings of weakness, chest pains, nausea, palpitations and shortness of breath (Kernan et al., 2014).

Stroke survivors manifest a number of physical, cognitive as well as psychological problems. Their bodies are often quite weak and prone to paralysis, suffer muscle spasticity, experience constantly changing sensations, and have problems

walking among many other issues (Kernan et al., 2014). Cognitive problems include attention deficits, memory loss, and poor misconception of available information. Concerning memory, survivors often longer than is expected to recall novel information and as such, cannot correctly to pay attention to an issue or not (Kernan et al., 2014). The poor memory translates into situations, where organization of thoughts is in most cases jumbles up as they poorly perceive issues around them. It is important to point out that more than half of stroke survivors will develop depression, which can vary in duration and severity (Kernan et al., 2014). This also results in challenges with appropriately communicating with close family members which can manifest as emotional problems.

3. Special part (case study)

3.1 Work methodology

I have done my bachelor's practice in semi-acute inpatient department at Ústřední vojenská nemocnice Prague 6, from 4 to 15. 1. 2015 my work was guided and supervised by Dis. Petr Smejkal. My thesis patient is a man who had a hemorrhagic stroke with left side hemiparesis. The patient has been informed about my thesis practice so we could cooperate and that his personal information, anamnesis and his present situation will be used (see Informed consent – Supplement no. 4, which was approved by the ethics committee Charles University - Supplement no. 5).

10 theraputic sessions was the time that I spend it with patient every morning in his room. Initial and final examinations were included in beginning of first session and at the beginning of last sessions respectively.

I used a measuring tape, plastic goniometry, crouches and neurological hammer during both initial and final examinations. Therapeutic band, crouches, walker device (Lite Gait) and compressive limb therapy- in some sessions- were used during the therapy sessions.

However, according to the instructions from the head doctor therapy procedure must follow the Gracies concept approach, mainly. DNS concept according to Kolar and PNF Kabat were also included in the therapy sessions.

3.2 Anamnesis

Student: Faisal Fahad Alharthi

Work Place: UVN

Supervisor name: Petr Smejkal. Dis

Responsible teacher: Mgr. Kateřina Holubová

Date: 4/1/2016

Examined person: C. M

Gender: Male

Age: 1968

Diagnosis: Hemorrhagic stroke in cerebellum from 4. 12. 2015 with hemiplegia (left side).

Status presence:-

Subjective:

The patient do not feel any pain and he complains about the disability to move his effected arm and leg.

Objective:

The patient was one month after the day he had the stroke. He was normal in the communication were he did not had any speech disorders. Cognition and orientation of time and place was normal. He was laying on the bed in supine position and uses urinary catheter. He has left hemi-paresis which influence the patient stability which effect his ability to sit, stand or walk without assistance but he was able to change his position in bed alone. He walks with walker on four points and therapist support.

Height: 185 cm.

Wight: 80 kg.

BMI: 23.4

Blood pressure: 132/78 mm Hg.

Heart rate: 78 beats/min.

History of the problem:

On the 4.12.2015 at 9:00 a.m. he could not move his left side of the body and he faced problems with speech at that time. However, he was still conscious then he was transported to the emergency department of the UVN hospital in Praha 6 where he

was diagnosed with Hemorrhagic stroke in cerebellum with left side hemiplagia, global aphasia and paresis of VI & VII nerves. He was in the Neurological in-patient department for 3 days then he has been moved to the Semi-acute patient.

Now days (first week of my practice) spastic pattern start to appear on the left side of the body in general and left hand fingers more. For two hours, due to the risk of the decubitus, patient ware an arm splint to keep the whole effected arm stretched. Transient dyskinesis of the effected side of the body of lower left limb (Patellar tendon and Triceps Surae muscles). He improved from the stability point of view and he restore the ability to sit alone and walk with one crutch which has 4 points in contact with the floor.

Motor development: Normal motor development.

Injuries anamnesis: Double fractures of left leg tibia when he skiing when he was around 13 years old which result in deference in the length of patients lower extremities. Left shoulder rotator cuff partial tear 2 years ago.

Past medical and surgical history: Left shoulder rotator cuff partial tear operation 2 years ago.

Medications, pharmacological anamnesis: Patient did not used any medications before the stroke. While he was in the emergency room he took: 1amp hydrocertison , 1amp ondansetron, 1000 ml FRC (Frixiparin) and 11.10 actilysa 9 ml. Nowadays, patient is using Citalec 1/day, Panadol 500mg 1.5 three times a day. Godasal, Connulex, Atorastatin Mylan, Moprilic and Frixiparin.

Allergic anamnesis: Bee stinking, Dust, flowers, Penicilin.

Abuses: When he was in the army he used to smoke 50 cig/day. He drinks alcohol occasionally, Coffee and do not use any drugs.

Smoking, alcohol occasionally, coffee 1/daily.

Family anamnesis: He do not know his father. His mother is 75 years old suffering from the same diagnosis and Hypertension. He do not have brothers and sisters but he has two kids.

Social anamnesis: He is divorced man but he still living with his wife on a block of flats in the 10th floor and he use the elevator.

Occupation anamnesis: He works as a builder.

Sport, regular physical activity: No regular sport or physical activity.

Previous rehabilitation:

Electrotherapy (DD) for pain management, analgetic effect, after the his left rotator cuff operation.

Patient medical documents:

- Paresis of (left side) facialis nerve
- Paresis of (right side) abdducens nerve.
- Left hand plegia.
- Left leg paresis.
- Good function of internal organs.

Indication of rehabilitation:

- Therapeutic examinations.
- Transfer.
- Verticalization.
- Training of stability.
- Gait training on 4 points.
- Exercises on neurological base.
- Prevention of shoulder pain, due to spasticity by positioning in (ABD + ER) for 30 min two times a day.
- Prevention of thromboembolism (TE).
- Logopedy.
- Ergo-therapy.
- Nursing rehabilitation (Walking and static biking).

3.3 Initial kinesiological examinations

The examination was done on Tuesday the 5th of Jan 2016 at morning time in the patient room.

3.3.1 Posture Examinations:

- Inspection: The patient could not stand without therapist assistance on right side and an assist device (one crutch at left side). The whole body is shifted to the right side (almost whole body weight on the right leg).

    - Back view:-

        - The base of support: Slightly narrow.
        - Shape and position of the ankle joints: Right side is ideal, left joint is in slight inversion.
        - Shape and thickness of the Achilles tendon: Right side is in ideal position , left side is stretched out-word. Right tendon is thicker than left tendon.
        - Contour of the calf muscles: Left leg calf muscles are in slight hypotrophy.
        - Shape and position of the knee joints: Right joint is in slight valgus.
        - Contour of the thigh muscles: Slight hypertrophy in right thigh muscles.
        - Position of pelvis: Right side is slightly higher.
        - Paravertebral muscles: Slight hypertrophy in left side muscles in lumbar area.
        - Curvature of the spine in the frontal plane: Slight ‘s’ shape at the frontal plane. Slight convex to the left side at the upper and medial thoracic. And to the right side at the lower thoracic and lumbar area were present.

- Position of the scapula: Left scapula in slight depression and slight internal rotation.
- Position of the shoulder: Right shoulder is slightly higher than left shoulder.
- Position of the head: Slightly rotated to the left side.

- Side view (left/right):-
  - Shape and position of the ankle joints: Slight dorsal flexion of the right foot and slight plantar flexion of the left foot.
  - Position of the knee joints: Left knee is full extended.
  - Contour of the thigh muscles: Both are symmetrical and the muscles mass more to anterior direction.
  - Position of the pelvis: Slight anterior tilt.
  - Curvature of the spine in sagittal plane: Slight lordosis in cervical spine, slight kyphosis in thoracic area and very slight lordosis in the lumbar spine.
  - Position of wrist and fingers: Left arm: Even though patient was holding the crutch his wrist was in very slight flexion. Fingers were slightly flexed due to crutch holding. But the right arm wrist was in neutral position and fingers were in slight flexion.
  - Position of elbow joints: Left side is slightly flexed even though he was holding the crutch.
  - Position of the shoulder girdle: Both shoulders are in protraction.
  - Trunk position: Slight rotation to right side.
  - Position of the head: Slight protraction.

- Front view:-
    - The base of support: Slightly narrow.
    - The position of the feet: Right side is ideal, left joint is in slight inversion.
    - The position and shape of the toes: Slight claws toes in both feet more on right side.
    - Weight distribution: Both on lateral edge of the foot.
    - Shape and position of the ankle joints: Right side is ideal, left joint is in slight inversion.
    - Configuration of m. tibialis anterior: Hypotrophy in left leg.
    - Contour of the calf muscles: Left calf muscles is in slight hypotrophy.
    - Shape and position of the knee joint: Both knees in slight outer rotation.
    - Shape of the thigh muscles: Slight hypertrophy in right thigh muscles.
    - Position of the pelvis: Right side is slightly higher.
    - Position of patient nipples: Right nipple is slightly higher than left side.
    - Position of the supraclavicular holes: Right side is slightly bigger than left side.
    - Position of the shoulder girdle: Right side is higher than left side.
    - Position of the arms: Both arms were slightly flexed due to the holding of crutch on left side and the therapist on right side.
    - Position of the head: Rotated to left side.

3.3.2 Palpation Examinations

Palpation of pelvis:

- Iliac crest: Left side is lower than right side.
- PSIS: Left side is lower than right side.
- ASIS: Left side is lower than right side.

Palpation conclusion: The pelvis is in lateral tilt to left side.

3.3.3 Gait Analysis:

Patient has in general very low stability. He uses one crutch by his left hand which has four points in contact with the ground. And he needs therapist support too.

- Width of the base of support: Slight narrow.
- Walking rhythm: Hemiplegic Gait
- Walking speed: Slow.
- Stride length: Asymmetric. Left step length is shorter than the right step.
- Movement of the foot: Ideal in right foot but no dorsal flexion on the left foot.
- Movement of knees joints: No full extension both knees more in left knee.
- Movement of hip joints: Slight extension in the left hip joint.
- Movement of the trunk: Fix in rotation to the left side with slight rotation movement of the trunk to other side while walking.
- Activity of back muscles: Activated (hyper) in low thoracic and (slight) lumbar area in both sides.
- Activity of abdomen muscles: Low activity in both sides more in left side.
- Position and movement of head: Tilted to the right side.

- Stability of walking: Very poor stability in walking and he needs support device and therapist assistant.
- Walk with eyes closed: Patient can't perform it.
- Walk backwards: Patient can't perform it.
- Walk up stretched arms: Patient can't perform it.
- Walk on tiptoe: Patient can't perform it.
- Walk on heels: Patient can't perform it.

3.3.4 Anthropometric Measurement Examination

Length (Anatomical):

	R	L
Whole lower limbs	90	87
Thigh	50	50
Leg	46	43

Table 1: Initial Anthropometric measurements of lower extremities.

3.3.5 ROM Examinations

Active	Passive
Cervical Spine: S: 60-0-40 F: 45-0-30 R: 75-0-60	Cervical Spine: S: 60-0-50 F: 45-0-35 R: 80-0-70
Shoulder: S: R: 45-0- 180 L: 10-0-40 F: R: 170-0-0 L: 20-0-0	Shoulder: S: R: 45-0- 180 L: 40-0-115 F: R: 180-0-0 L: 45-0-20

T: R: 100-0-30 L: The patient could not perform the right starting position (90 degree of flexion) R: R: 90-0-70 L: The patient could not perform the right starting position (90 degree of flexion)	T: R: 90-0-30 L: 50-0-10 R: R: 90-0-70 L: 70-0-60
Elbow: S: R: 0-0-145 L: 0-20-145	S: R: 0-0-145 L: 0-0-145
Forearm: R: R: 90-0-90 L: 0-90-90	R: R: 90-0-90 L: 10-90-90
Wrist: S: R: 70-0-80 L: Patient could not perform the test. F: R: 20-0-45 L: Patient could not perform the test.	S: R: 70-0-80 L: 40-0-70 F: R: 20-0-45 L: 20-0-35
2nd Interphalangeal joint 1st finger: S: R: 0-0-70 L: 0-10-70 2nd Interphalangeal joint 2nd finger: S: R: 0-0-70 L: 0-60-70 2nd Interphalangeal joint 3rd finger: S: R: 0-0-70 L: 0-50-70 2nd Interphalangeal joint 4th finger: S: R: 0-0-70 L: 0-55-70 2nd Interphalangeal joint 5th finger: S: R: 0-0-70 L: 0-60-70	2nd Interphalangeal joint 1st finger: S: R: 0-0-70 L: 0-0-70 2nd Interphalangeal joint 2nd finger: S: R: 0-0-70 L: 0-15-70 2nd Interphalangeal joint 3rd finger: S: R:0-0-70 L: 0-5-70 2nd Interphalangeal joint 4th finger: S: R:0-0-70 L: 0-10-70 2nd Interphalangeal joint 5th finger: S: R: 0-0-70 L: 0-15-70
1st Interphalangeal joint 1st finger: S: R: 0-0-70 L: 0-5-70 1st Interphalangeal joint 2nd finger: S: R: 0-0-100 L: 0-90-100	1st Interphalangeal joint 1st finger: S: R: 0-0-70 L: 0-0-70 1st Interphalangeal joint 2nd finger: S: R: 0-0-100 L: 80-90-100

1st Interphalangeal joint 3rd finger: S: R: 0-0-100 L: 0-90-100 1st Interphalangeal joint 4th finger: S: R: 0-0-100 L: 0-90-100 1st Interphalangeal joint 5th finger: S: R: 0-0-100 L: 0-95-100	1st Interphalangeal joint 3rd finger: S: R: 0-0-100 L: 85-90-100 1st Interphalangeal joint 4th finger: S: R: 0-0-100 L: 80-90-100 1st Interphalangeal joint 5th finger: S: R: 0-0-100 L: 75-90-100
Metocarpophalangeal joint 2nd finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 3rd finger: S: R: 0-0-90 L: 0-10-90 Metocarpophalangeal joint 4th finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 5th finger: S: R: 0-0-90 L: 0-5-90	Metocarpophalangeal joint 2nd finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 3rd finger: S: R: 0-0-90 L: 0-10-90 Metocarpophalangeal joint 4th finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 5th finger: S: R: 0-0-90 L: 0-5-90
Hip: S: R: 10-0-125 L: 0-0-50 F: R: 45-0-10 L: 35-0-10 R: R: 45-0-45 L: 0-0-10	 S: R: 10-0-125 L: 10-0-100 F: R: 45-0-10 L: 45-0-10 R: R: 45-0-45 L: 25-0-40
Knee: S: R: 0-0-140 L: 0-0-100	 S: R: 0-0-140 L: 0-0-110
Ankle: S: R: 20-0-45 L: 0-20-35 R: R: 20-0-40 L: 0-10-25	 S: R: 20-0-45 L: 15-20-45 R: R: 20-0-40 L: 5-10-40

Table 2: Initial ROM examinations.

3.3.6 Facial Muscles Strength Test

Muscles	L	R
M. frontalis	5	5
M. orbicularis oculi	5	5
M. corrugator supercilii	5	5
M. procerus	4	5
M. nasalis	4	5
M. orbicularis oris	3	5
M. zygomaticusmajor a m. risorius	3	5
M. levator anguli oris	3	5
M. depressor labii inferioris	4	5
M. depressor anguli oris	3	5
M. mentalis	4	5
M. buccinators	3	5
M. platysma	4	5

Table 3: Facial muscles strength test.

3.3.7 Muscles tonicity examinations by palpation

- Biceps brachii muscles:

  L: Slight hypertonicity. R: Normtonicity.

- Triceps brachii muscles:

  L: Slight hypotonicity. R: Normtonicity.

- Flexors digiti muscles:

  L: Slight hypertonicity. R: Normtonicity.

- Extensors digiti muscles:

  L: Slight hypotonicity. R: Slight hypertonicity.

- Quardicips femoris muscles:

  L: Slight hypertonicity. R: Slight hypertonicity.

- Hamstrings muscles:

  L: Slight hypertonicity. R: Normtonicity.

- Tibialis anterior muscles:

  L: Slight hypotonicity. R: Normtonicity.

- Triceps surae muscles:

  L: Slight hypertonicity. R: Normtonicity.

3.3.8 Neurological Examination

- Mental status:
  - ✓ Patient is orientated from the time and place point of view.
  - ✓ No impairment in communication abilities.
  - ✓ Memorizing ability is good.
  - ✓ Patient do not suffer from any speech problems.

- Examination of cranial nerves :

Nerve No.	Nerve Name	Result
I	Ophthalmic	Physiological
II	Optic	Physiological
III	Okulomotorius	Physiological
IV	Trochlearis	Physiological
V	Trigeminus	Physiological

VI	Abdducens	Right side is impaired
VII	Facialis	Left side is impaired
VIII	Vestibulocochlearis	Physiological
IX	Glossopharyngeal	Physiological
X	Vagus	Physiological
XI	Accesorius	Physiological
XII	Hypoglossal	Physiological

Table 4: Initial cranial nerves examinations.

- Examination of cerebellum:
    - Finger-nose attempt: Patient could not perform the test due to left arm paresis. Negative result for the right arm.
    - Finger-finger attempt: Patient could not perform the test due to left arm paresis. Negative result for the right arm.
    - Nystagmus test: Slightly nystagmus to the right direction.
    - Arm drift test: Patient could not perform the test due to left arm paresis. Negative result for the right arm.
- Proprioceptors examinations:
    - Romberg I: Poor stability. Patient stands with one crutch (four points contact with floor) and he needs therapist assistance.
    - Romberg II and III: I did not continue for the II and III Romberg test due to the result of the first examinations.

- Specific neurological test:
    - Paretic test:
        - Mingazzini test upper extremities: Patient could not perform the test due to left arm paresis. Negative result for the right arm.

        - Mingazzini test lower extremities: Negative for both legs.

    - Pyramidal test:
        - Trömner signs: Negative in both hands.
        - Hoffman test: Negative in both hands.
        - Openheim test: Negative in both legs.
        - Chaddock's Sign: Negative in both legs.
        - Babinski test: Positive in left foot and negative in the right foot.

- Ashworth scale test for spasticity:

Muscles	Result
Biceps brachii	1
Flexor carpi ulnaris	1
Flexor Carpi Radials	1+
Flexors Digitorum Profundus	1+
Adductor Pollicis	0
Hamstrings	1
Quadriceps	2
Gastrocnemius	2
Soleus	2

Table 5: Ashworth scale for spasticity.

- Sensation examinations:
    - Upper limb:-
        - Superficial sensation (light touch):-
            - C5 :

              L: Decresed R: Normal

- C6:

  L: Normal R: Normal

- C7:

  L: Normal R: Normal

- C8

  L: Normal R: Normal

- T1

  L: Normal R: Normal

- T2:

  L: Decresed R: Normal

- T3:

  L: Decresed R: Normal

▪ Deep sensation (position):

- Fingers:

  L: Normal R: Normal

- Big toe:

  L: Decreased R: Normal

- Other toes:

  L: Normal R: Normal

- Littile toe:

  L: Normal R: Normal

▪ Deep sensation (pain):

- C5 :

  L: Normal R: Normal

- C6:

  L: Normal R: Normal

- C7:

  L: Decresed R: Normal

- C8

  L: Normal R: Normal

- T1

  L: Normal R: Normal

- T2:

  L: Normal R: Normal

- T3:

  L: Normal R: Normal

- Lower limb:-
  - Superficial sensation (light touch):-
    - L2:

      L: Normal R: Normal

    - L3:

      L: Normal R: Normal

    - L4:

      L: Normal R: Normal

    - L5:

      L: Decresed R: Normal

    - S1:

      L: Decresed R: Normal

- S2:

  L: Normal R: Normal

- Deep sensation (position):
  - 2nd finger:

    L: Decreased R: Normal

  - 3rd finger:

    L: Decreased R: Normal

  - Big toe:

    L: Decreased R: Normal

  - Other toes:

    L: Normal R: Normal

  - Littile toe:

    L: Normal R: Normal

- Deep sensation (pain):
  - L2:

    L: Decresed R: Normal

  - L3:

    L: Decresed R: Normal

  - L4:

    L: Decresed R: Normal

  - L5:

    L: Decresed R: Normal

  - S1:

    L: Decresed R: Normal

- S2:

  L: Normal R: Normal

- Deep tendon reflexes:
  - Biceps C5-C6:

    L: 3 R: 2
  - Triceps C7:

    L: 3 R: 1
  - Flexors C8:

    L: 3 R: 1
  - Patellar L2-L4:

    L: 3 R: 2
  - Achilles L5-S2:

    L: 3 R: 2

- Ankle clonus test: Left joint is positive.

- Abdominal reflexes:
  - T5-T7:

    L: 2 R: 2
  - T7-T9:

    L: 0 R: 1
  - T9-T11:

    L: 0 R: 1
  - T10-T12:

    L: 1 R: 1

3.3.9 ADL Evaluation

The patient could verticalized himself alone from laying to sitting but he needs therapist assist and a crutch to go to standing position. He had to take more than usual time to wear his T-shirt and his slippers due to the difficulties to abduct and flex the whole arm also the disability to move the ankle joint to the dorsal flexion and aversion. He could not stand and walk alone he needs therapist assistants from right side and needs one crutch form the left side. During eating he used his right healthy hand but he could use also his effected hand to hold for example the orange. Generally, he is using his right arm for everything he needs to do.

Barthel test:

Activity	Result
Stool incontinence	10
Urinary incontinence	The patient use urinary catheter.
Grooming	8
Toilet use	7
Feeding	10
Transfers	9
Walking	6
Dressing	5
Climbing stairs	0
Bathing	7
Sum of results: 62 /100	

Table 6: Barthel test.

Assessment test :

0-20 points : Total dependent .

21-60 points : Severe dependent.

61-90 points : Moderate dependent.

91-99 points : Slight dependent.

10 points: Independent.

The conclusion of the Barthel test: According to Barthel index the patient is moderate dependent.

3.3.10 Initial Examinations Conclusion

49 years old male patient is suffering from Hemorrhagic stroke in cerebellum with left side hemiplegia. During the initial physical therapy examinations on the 5/1/2016 we found the following findings:

The patient did not had any pain and he was complaining from the disability of moving the left arm and leg. He had a urinary catheter. Spastic pattern slightly influence his body posture slightly on the left side of the body. The patient could not stand without therapist assistance and an assist device (one crutch which has four points in contact with the ground). The whole body was shifted to the right side which influences the pelvis position to lateral tilt (left side). He had in general very low stability. The main finding in gait examination was the absent of dorsal flexion in his left foot and the slight circumduction of left leg movement. Lower range of extension movement in both knees more in left knee was observed.

Obvious deference in the length of his lower extremities was founded due to his ski injury when he was 13 years old (double fracture in left Tibia bone). Moderate limitation in the range of motion to extension direction was present in left body side in shoulder, elbow and wrist joints also in distal and proximal interphalangeal joints. Hip and knee joints have slight limitation in the extension direction. Also, marked limitation was in the ankle joint to dorsal flexion direction.

According to Ashworth scale test for spasticity the result shows slight increase in muscle tone, manifested by a catch or by minimal resistance at the end of the

range of motion (ROM) when the affected part(s) is moved in flexion or extension in Biceps brachii, Flexor carpi ulnaris and Hamstrings. Also, Slight increase in muscle tone, manifested by a catch followed by minimal resistance throughout the remainder (less than half of the ROM in Flexor carpi radialis and Flexors Digitorum Profundus. On the other hand, no increase in muscle tone in Adductor Pollicis and More marked increase in muscle tone through most of the ROM, but affected part (s) easily moved in Quadriceps, Gastrocnemius and Soleus.

From the mental status point of view he was in a good condition. The 6^{th} and 7^{th} cranial nerves we impaired in right and left sides respectively. Slight nystagmus movement was present to the right direction of the right eye. The patient was not able to perform the Romberg I test without the using crutches and the support from the therapist. Mingazzini test for upper and lower extremities were positive. Pyramids track examinations show positivity in the Babinski test. The patient has hyper reflexes in the left side of his body during the deep tendon reflexes test also he had a clonus movement in his left leg. Finally, the patient is considered as a moderate dependent patient according to the Barthel scale classification.

3.3.11 Goals of Therapy

- Spasticity prevention.
- Improve verticalization (sitting and standing).
- Increase ROM in shoulder, wrist, interphalangeal, hip, knee and ankle joints in flexion and extension directions.
- Increase muscles strength Triceps brachii, Extensors carpi ulnaris, Extensors carpi radialis, Extensors digiti muscles, Hamstrings muscles, Tibialis anterior muscle and trunk muscles.
- Improve gait including climbing stairs.
- Improve patient stability.
- Restore and improve leg and foot movement and coordination in the effected side and improve hand coordination and function of griping.
- Increase self-sufficiency.

3.3.12 Short-Term Plan

- Spasticity prevention according to Gracies Concept starting by progressive stretching, active repetitive movements and active movements of Flexors digitorum, Flexors carpi ulnaris, Flexors carpi radialis, Biceps brachii and Triceps surae muscles.
- PNF strengthening techniques to strength weak muscles
- Passive Stretching for shortened muscles Triceps surae muscles, Rotator cuff muscles and Hamstrings muscles.
- ROM exercises for shoulder joint by flexing, extending, external and internal rotating the joint passively for 10 times each direction. Active ROM exercises for knee joint in flexion and extension combined with the hip joint movement of the same directions for 10 times. Also, active abduction and adduction exercises for hip joint for 10 times.
- verticalization (sitting and standing).
- Improve gait including climbing stairs.

3.3.13 Long-Term Plan

- Stretching exercises for Flexors digitorum, Flexors carpi ulnaris, Flexors carpi radialis, Biceps brachii and Triceps surae muscles.
- ROM exercise for shoulder joint by flexing, extending, external and internal rotating the joint passively for 10 times each direction. Active ROM exercises for knee joint in flexion and extension combined with the hip joint movement of the same directions for 10 times. Also, active abduction and adduction exercises for hip joint for 10 times.
- Muscle strengthening exercises for Triceps brachii, Extensors carpi ulnaris, Extensors carpi radialis, Extensors digiti muscles with resistance. Hamstrings muscles, Tibialis anterior muscle with weights, and Deep stabilization muscles by exercises according to DNS.
- Gait training in different forms as side and back walking.

- Sensomotoric exercises to improve stability in different levels according to the patient state.
- Restore and improve coordination and strength of left leg and left arm with focusing on the functional abilities as shoulder and knee stability, griping and writing.
- Reeducate patient arm and hand movement according to his previous job to improve muscles coordination.

3.3.14 Day to Day Therapy

- **5/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view. He was in active and enthusiastic mode. He was using urinary catheter.
  - Subjective: No pain was reported at that time but he complains about the disability to move his effected arm and leg.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the hip and knee joints.
  - Strength left arm muscles, left seratus anterior, hip and knee flexors, trunk muscles and Gluteus maximus muscles.

  Therapy unit:

  - Gracieswhich was a progressive .concept for the left arm and leg mints for the left wrist and fingers joints in on time 10stretching around to the direction of dorsal flexion of wrist and extension of fingers to effect Flexor digitorum, Flexor pollicis longus, Flexor carpi radialis and Flexor carpi ulnaris muscles. Repeated and fast passive movements

around 15 times from neutral position to the same direction as the progressive stretching applied (dorsal direction of the wrist and extension in fingers in the same time). Then instruct the patient to do the movements actively. The whole process was repeated for the elbow joint to the direction of extension combined with pronation of the forearm to effect Pronator teres and Biceps brachii muscles, ankle joint in dorsal flexion to effect the Triceps surae, knee joint in flexion to effect Quadriceps muscles and hip joint in flexion to effect Gluteus maximus muscle. (knee and hip joints in the same time).

- Active ROM exercises of the hip joint to the abduction and adduction direction. Also, hip and knee joints in flexion and extension directions by flex and extend both joints to the maximum in the same time while the patient is in prone position.
- PNF strengthening Repeated Contractionst diagonal 1technique in Extensor ,for the left arm to affect Interossei dorsales muscles extension Triceps brachii ,Extensor digitorum muscle ,pollicis longus muscle muscles and Latissimus dorsi of the body left side. The same technique is applied for the pelvis from both sides to anterior elevation direction to effect Obliqus abdominis internus ipsilateral muscle, Obliqus abdominis externus contralateral muscle.
- Isometric strengthening exercise of left side Seratus anterior muscle by pushing the therapist hand while the patient in supine position with extended arm for improve the stability of the shoulder.
- Gluteus maximus strengthening exercise by elevation of the pelvis from the bed while the patient is in prone position and support himself by his arms.

- **6/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view. He still uses urinary catheter.
  - Subjective: He did not feel any pain.

Goal of therapy unit:

- Spasticity prevention by using Gracies.concept
- Improve ROM of the elbow and hip joint.
- Strength left arm muscles, pelvis muscles and Gluteus maximus.
- Improve gait.

Therapy unit:

- GraciesFlexor ,Flexor pollicis longus ,concept for Flexor digitorum ,Biceps brachii ,Pronator teres ,carpi radialis and Flexor carpi ulnaris Gluteus maximus muscle ,Triceps surae Quadricepss.
- Active ROM movement to the extension direction of the elbow joint while patient in prone position and fixating the distal part of the humerus bone in 90 degree flexion of the shoulder to help make the exercise easier for the patient.
- Active ROM movement of the hip joint to the abduction and adduction direction and to the flexion/extension with knee joint too.
- PNF strengthening Repeated Contractionst diagonal 1technique in extension for the left arm also in anterior elevation direction of pelvis in both sides.
- Gluteus maximus strengthening exercise by elevation of the pelvis from the bed while the patient is in supine position and support himself by his arms.
- Gait training in the hospital corridor in straight form of walking using one crutch which has four point contact on the floor and with the therapist support.

- **7/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view. He was in active and enthusiastic mode. He was without urinary catheter.
  - Subjective: Very slight pain with slight tension and slight numbness feeling was reported at night time in the plantar side of the foot, calf muscles and more in left hand palm area. The pain wasn't a continuous feeling.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the knee and hip joints.
  - Relax left arm muscles.
  - Improve gait.

  Therapy unit:

  - GraciesFlexor pollic ,concept for Flexor digitorum is longus, Flexor carpi radialis and Flexor carpi ulnaris, Pronator teres, Biceps brachii, Triceps surae Quadriceps, Gluteus maximus muscles.
  - Active ROM movement of the hip joint to the abduction and adduction direction and flexion/extension of the hip and knee joints while the patient is in prone position. Each exercise for 10 repetitions.
  - PNF Contraction-relaxation technique in 1st diagonal extension to relax Interossei palmares muscles, Flexor digitorum muscles, Flexor pollicis longus muscle, Flexor carpi radialis muscle, Flexor carpi ulnaris muscle, Biceps brachii muscles, and Pectoralis major muscle.

- Gait training in the hospital corridor in straight form of walking using one crutch which has four point contact on the floor and with the therapist support.

- **8/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view.
  - Subjective: No pain was reported.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the knee and hip joints.
  - Strength whole left leg muscles.
  - Strength deep stabilization muscles.
  - Improve gait.

  Therapy unit:

  - GraciesFlexor ,Flexor pollicis longus ,concept for Flexor digitorum Biceps brachii ,Pronator teres ,carpi radialis and Flexor carpi ulnaris, Triceps surae Quadriceps, Gluteus maximus muscles.
  - Active ROM exercises of the hip joint to the abduction and adduction direction for 10 repetitions.
  - PNF strengthening Repeated Contraction1technique pattern in st diagonal flexion of the left leg to effect Extensor digitorum, Extensor hallucis longus/brevis, Tibialis anterior, Interossi dorsales, Semimembranosus, Semitendinosus, Iliopsoas, Obturatorius externus, Pectineus, Gracilis, Adductor longus/brevis, Sartorius, Rectus femoris.
  - Gluteus maximus strengthening exercise by elevation of the pelvis from the bed. With facilitation by pressing both knees to down word direction

(to the bed). The patient is in supine position and support himself by his arms.

- Isometric strengthening exercise of left side Seratus anterior muscle by pushing the therapist hand while the patient in supine position with extended arm for improve the stability of the shoulder.
- Self stretching of the whole body in prone position. Patient in prone position with stretch arms and dorsal flexion of the feet and try to provide self stretching of the whole body from the tips of fingers to the heels and feel the elongation of the spine.
- Strengthening of the hamstrings muscles by using Thera-band. Patient in prone position with knee joint flexed of the side which we would like to strength the hamstrings muscles in then the therapist hold the Thera-band from sides and surround the part above the ankle joint to apply resistant to the direction for knee flexion. The same exercise was done to strength the Quadriceps muscles but the resistant was applied to the opposite of knee extension.
- On four position is when patient is on his knees and hands to support him and maintain this position for at least one minute , according his situation, with therapist visual control to keep the correct posture of the patient body. It is done to improve deep stabilization muscles.
- Modified “on four position” by simulating crawling movement. The patient extends one hand and maintain the position then by slight extension of one leg and maintain the position to improve deep stabilization muscles.
- Gait training in the hospital corridor in straight form of walking using one crutch which has four point contact on the floor and with the therapist support.

- **11/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view.
  - Subjective: No pain was reported.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the knee and hip joints.
  - Strength Gluteus maximus muscles.
  - Strength deep stabilization muscles.
  - Improve gait.

  Therapy unit:

  - GraciesFlexor ,icis longusFlexor poll ,concept for Flexor digitorum Pronator ter ,carpi radialis and Flexor carpi ulnarises, Biceps brachii, Triceps surae Quadriceps, Gluteus maximus muscles.
  - Active ROM exercises of the hip joint to the abduction and adduction direction. Flexion and extension exercises of the hip combined with the knee joint
  - Gluteus maximus strengthening exercise by elevation of the pelvis from the bed. With facilitation by pressing both knees to down word direction (to the bed). Patient is in supine position.
  - On four position.
  - Modified “on four position”.
  - Gait training in the hospital corridor in straight form of walking using one normal crutch which has one point contact on the floor and with the therapist visual control only.

- **12/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view. His left arm was slight swelling more in distal part.
  - Subjective: Slight pain was in the left hand and wrist area.

  Goal of therapy unit:

  - Decrease left arm swelling.
  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the knee and hip joints.
  - Strength Gluteus maximus muscles.
  - Improve gait.

  Therapy unit:

  - Lymph drainage machine (compressive limb therapy) to reduce the swelling in the patient left whole arm.
  - GraciesFlexor ,Flexor pollicis longus ,or digitorumconcept for Flex carpi radialis andFlexor carpi ulnaris, Pronator teres, Biceps brachii, Triceps surae Quadriceps, Gluteus maximus muscles.
  - Active ROM exercises of the hip joint to the abduction and adduction direction. For 12 repetitions.
  - Gluteus maximus strengthening exercise by elevation of the pelvis from the bed. With facilitation by pressing both knees to down word direction (to the bed). Patient is in supine position.
  - Gait training in the hospital corridor in straight form of walking with a stick with the therapist visual control.

- **13/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view. The was slight swelling in the left arm but it was less than the day before.
  - Subjective: No pain was reported.

  Goal of therapy unit:

  - Decrease arm swelling.
  - Spasticity prevention by using Gracies.concept
  - Improve ROM of the knee and hip joints.
  - Strength Gluteus maximus muscles.
  - Strength deep stabilization muscles.
  - Improve gait.

  Therapy unit:

  - Lymph drainage machine (compressive limb therapy) to reduce the swelling in the patient left whole arm.
  - GraciesFlexor ,Flexor pollicis longus ,concept for Flexor digitorum ,ps brachiiBice ,Pronator teres ,carpi radialis and Flexor carpi ulnaris Triceps surae Quadriceps and Gluteus maximus muscles.
  - Active ROM exercises of the hip joint to the abduction and adduction direction. For 12 repetitions.
  - Gluteus maximus strengthening exercise by elevation of the pelvis from the bed. With facilitation by pressing both knees to down word direction (to the bed). Patient is in supine position.
  - On four position.
  - Modified “on four position”.

- Gait training in the hospital corridor in straight form of walking with a special devise to improve the gait with high safety control by holding the patient by belts connected to the device. This device called (Lite Gait) this therapy is under the therapist visual control only.

- **14/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view.
  - Subjective: No pain was reported.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Strength deep stabilization muscles.
  - Improve gait.

  Therapy unit:

  - GraciesFlexor ,Flexor pollicis longus ,concept for Flexor digitorum carpi radialis and Flexor carpiulnaris, Pronator teres, Biceps brachii, Triceps surae Quadriceps, Gluteus maximus muscles.
  - On four position.
  - Modified “on four position”.
  - Gait training in the hospital corridor in straight form of walking by the (Lite Gait) device with the therapist visual control.

- **15/1/2016:**

  The patient had low health condition were he has low blood pressure: 107/72 and with heart rate: 80. So I could not perform with him any therapy according to the doctor instructions. Due to this situation I had to come one day more on the Monday the 18/1/2016 to do the last therapy session and the final examinations.

- **18/1/2016:**

  Present state:

  - Objective: The patient was normal in the communication, cognition and orientation point of view.
  - Subjective: No pain was reported.

  Goal of therapy unit:

  - Spasticity prevention by using Gracies.concept
  - Strength deep stabilization muscles.
  - Improve gait.

  Therapy unit:

  - The final examinations.
  - GraciesFlexor ,Flexor pollicis longus ,concept for Flexor digitorum carpi radialis and Flexor carpiulnaris, Pronator teres, Biceps brachii, Triceps surae Quadriceps, Gluteus maximus muscles.
  - On four position.
  - Gait training in the hospital corridor in straight form of walking by the (Lite Gait) device with the therapist visual control.

3.4 Final Kinesiological Examinations

The examination was done on Tuesday the 18th of Jan 2016 at morning time in the patient room before we start the final therapeutic session.

Status presence:-

Subjective:

The patient feels better than before and do not feel any pain. He still complains about the disability to move his effected arm and leg and he was complaining about the feelings of muscles tension (as cramps) at night time on his effected side of his body.

Objective:

The patient now is one month and a half after he had the stroke. He has been improved generally. He could move himself without any help from lying to sitting and from sitting to standing. He could walks with one crutch and without therapist support.

3.4.1 Postural examinations

- Inspection: The patient could stand without therapist assistance and an assist device (crutches). The whole body is shifted to the right side (almost whole body weight on the right leg).

    - Back view:-
        - The base of support: Slightly narrow.
        - Shape and position of the ankle joints: Left joint is in slight inversion.
        - Shape and thickness of the Achilles tendon: Right side is in ideal position , left side is stretched out-word slightly. Right tendon is thicker than left tendon.
        - Contour of the calf muscles: Left leg calf muscles are in slight hypotrophy.
        - Shape and position of the knee joints: Right joint is in slight valgus.

- Contour of the thigh muscles: Right leg thigh muscles are in slight hypertone.
- Position of pelvis: Lateral tilt to the left.
- Paravertebral muscles: Right side is in slight hypertone.
- Curvature of the spine in the frontal plane: Very Slight ‘s’ shape at the frontal plane. Slight convex to the left side at the upper and medial thoracic. And to the right side at the lower thoracic and lumbar area were present.
- Position of the scapula: Left scapula is in slight adduction.
- Position of the shoulder: Left shoulder is slight higher than right shoulder.
- Position of the head: Slight rotation to the left side.

- Side view (left/right):-
  - Shape and position of the ankle joints: Left joint is in slight plantar flexion direction. Right joint is in slight dorsal flexion direction.
  - Position of the knee joints: Right knee is flexed more than the left knee joint.
  - Contour of the thigh muscles: Left thigh muscles are in slight hypotrophy.
  - Position of the pelvis: Slightly in anterior tilt.
  - Position of wrist and fingers: Left arm was in slight flexion. Fingers were markedly flexed. But the right arm wrist was in neutral position and fingers were in slight flexion.
  - Position of elbow joints: Right joint is in slight flexion.
  - Position of the shoulder girdle: Both in slight protraction.
  - Trunk position: Slight rotation to the right side.

- Position of the head: In slight protraction.

- Front view:-
  - The base of support: Slightly narrow.
  - The position of the feet: Left foot is in slight eversion and right foot is in slight inversion.
  - The position and shape of the toes: Left foot toes are in slight claws right foot toes highly pressing on floor.
  - Weight distribution: On right side.

  - Shape and position of the ankle joints: Ideal in both side.
  - Configuration of m. Tibialis anterior: Ideal in both sides.
  - Contour of the calf muscles: Left side is in slight hypotone.
  - Shape and position of the knee joint: Both are in slight flexion more is the right joint.
  - Shape of the thigh muscles: Ideal in both sides.
  - Position of the pelvis: Lateral tilt to the left.
  - Position of patient nipples: Left one is slightly higher than the right.
  - Position of the supraclavicular holes: Left side is slightly bigger.
  - Position of the arms: Both arms were slightly flexed due to the holding of crutch on left side and the therapist on right side.
  - Position of the shoulder girdle: Left side is slightly higher.
  - Position of the head: Slightly rotated to the left side.

3.4.2 Palpation Examinations

Palpation of pelvis:

- Iliac crest: Left side is lower than right side.
- PSIS: Left side is lower than right side.
- ASIS: Left side is lower than right side.

Palpation conclusion: The pelvis is in slight lateral tilt to left side.

3.4.3 Gait Analysis

The patient could walk with one crutch (stick) from his left side and without the support of the therapist. He uses one time per day a special gait training machine called (Lite Gait) which helps him to walks alone and improve his stability and muscles strength. When he walks his body is swinging slightly (left to right).

- Width of the base of support: Normal width.
- Walking rhythm: Hemiplegic Gait.
- Walking speed: Slowly.
- Stride length: Asymmetric. Left step length is shorter than the right step.
- Movement of the foot: Left foot is without inversion and dorsal flexion movement.
- Movement of knees: Both joints are without full extension.
- Movement of hip joints: Slight extension in the left hip joint.
- Movement of whole leg: Circumduction movement.
- Position and movements of the pelvis: Slight swinging to left and right.
- Position and movement of the trunk: Swinging to left and right sides.
- Activity of back muscles: Symmetrical activation of both sides.
- Activity of abdomen muscles: No activation of both sides.

- Position and movement of head: No movement (Stiff).
- Stability of walking: Fair stability.
- Walk backwards: Slight extension of the left hip joint.
- Walk up stretched arms: Patient can't perform it.
- Walk on tiptoe: Patient can't perform it.
- Walk on heels: Patient can't perform it.

3.4.4 Anthropometric Measurement Examination

Length:

	R	L
Whole lower limbs	90	87
Thigh	50	50
Leg	46	43

Table 7: Final Anthropometric measurements of lower extremities.

3.4.5 ROM Examinations

Active	Passive
Cervical Spine: S: 55-0-45 F: 45-0-30 R: 75-0-65	Cervical Spine: S: 60-0-50 F: 45-0-40 R: 80-0-70
Shoulder: S: R: 45-0- 180 L: 10-0-20 F: R: 170-0-0 L: 20-0-0	Shoulder: S: R: 45-0- 180 L: 40-0-160 F: R: 180-0-0 L: 90-0-20

T: R: 100-0-30 L: The patient could not perform the right starting position (90 degree of flexion) R: R: 90-0-70 L: The patient could not perform the right starting position (90 degree of flexion)	T: R: 90-0-30 L: 90-0-30 R: R: 90-0-70 L: 80-0-60
Elbow: S: R: 0-0-145 L: 0-45-120	S: R: 0-0-145 L: 0-0-145
Forearm: R: R: 90-0-90 L: 0-80-90	R: R: 90-0-90 L: 70-80-90
Wrist: S: R: 70-0-80 L: Patient could not perform the test. F: R: 20-0-45 L: Patient could not perform the test.	S: R: 70-0-80 L: 70-0-80 F: R: 20-0-45 L: 20-0-40
2nd Interphalangeal joint 1st finger: S: R: 0-0-70 L: 0-10-70 2nd Interphalangeal joint 2nd finger: S: R: 0-0-70 L: 0-60-70 2nd Interphalangeal joint 3rd finger: S: R: 0-0-70 L: 0-50-70 2nd Interphalangeal joint 4th finger: S: R: 0-0-70 L: 0-55-70 2nd Interphalangeal joint 5th finger: S: R: 0-0-70 L: 0-60-70	2nd Interphalangeal joint 1st finger: S: R: 0-0-70 L: 5-10-70 2nd Interphalangeal joint 2nd finger: S: R: 0-0-70 L: 40-60-70 2nd Interphalangeal joint 3rd finger: S: R:0-0-70 L: 45-50-70 2nd Interphalangeal joint 4th finger: S: R:0-0-70 L: 45-55-70 2nd Interphalangeal joint 5th finger: S: R: 0-0-70 L: 45-60-70
1st Interphalangeal joint 1st finger: S: R: 0-0-70 L: 10-15-70 1st Interphalangeal joint 2nd finger: S: R: 0-0-100 L: 0-90-100 1st Interphalangeal joint 3rd finger:	1st Interphalangeal joint 1st finger: S: R: 0-0-70 L: 75-15-70 1st Interphalangeal joint 2nd finger: S: R: 0-0-100 L: 75-90-100 1st Interphalangeal joint 3rd finger:

S: R: 0-0-100 L: 0-90-100 1st Interphalangeal joint 4th finger: S: R: 0-0-100 L: 0-90-100 1st Interphalangeal joint 5th finger: S: R: 0-0-100 L: 0-90-100	S: R: 0-0-100 L: 80-90-100 1st Interphalangeal joint 4th finger: S: R: 0-0-100 L: 75-90-100 1st Interphalangeal joint 5th finger: S: R: 0-0-100 L: 75-90-100
Metocarpophalangeal joint 2nd finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 3rd finger: S: R: 0-0-90 L: 0-10-90 Metocarpophalangeal joint 4th finger: S: R: 0-0-90 L: 0-5-90 Metocarpophalangeal joint 5th finger: S: R: 0-0-90 L: 0-5-90	Metocarpophalangeal joint 2nd finger: S: R: 0-0-90 L: 5-5-90 Metocarpophalangeal joint 3rd finger: S: R: 0-0-90 L: 10-10-90 Metocarpophalangeal joint 4th finger: S: R: 0-0-90 L: 5-5-90 Metocarpophalangeal joint 5th finger: S: R: 0-0-90 L: 5-5-90
Hip: S: R: 10-0-125 L: 0-0-50 F: R: 45-0-10 L: 45-0-10 R: R: 45-0-45 L: 10-0-20	 S: R: 10-0-125 L: 10-0-125 F: R: 45-0-10 L: 45-0-10 R: R: 45-0-45 L: 35-0-45
Knee: S: R: 0-0-140 L: 0-0-120	 S: R: 0-0-140 L: 0-0-140
Ankle: S: R: 20-0-45 L: 20-20-35 R: R: 20-0-40 L: 10-10-25	 S: R: 20-0-45 L: 5-20-45 R: R: 20-0-40 L: 10-10-40

Table 8: Final ROM examinations.

3.4.6 Muscles Tonicity Examinations by Palpation:

- Biceps brachii muscles:

  L: Normtonicity R: Normtonicity.

- Triceps brachii muscles:

  L: Normtonicity R: Normtonicity.

- Flexors digiti muscles:

  L: Hypertonicity R: Normtonicity.

- Extensors digiti muscles:

  L: Hypertonicity R: Slight hypertonicity.

- Quardicips femoris muscles:

  L: Hypertonicity R: Slight hypertonicity.

- Hamstrings muscles:

  L: Slight hypertonicity R: Normtonicity.

- Tebialis anterior muscles:

  L: Slight hypotnicity R: Normtonicity.

- Triceps surae muscles:

  L: Hypertonicity R: Normtonicity.

3.4.7 Neurological Examination

- Mental status:
  - ✓ Patient is orientated from the time and place point of view.
  - ✓ No impairment in communication abilities.
  - ✓ Memorizing ability is good.
  - ✓ Patient do not suffer from any speech problems.

- Examination of cranial nerves :

Nerve No.	Nerve Name	Result
I	Ophthalmic	Physiological
II	Optic	Physiological
III	Okulomotorius	Physiological
IV	Trochlearis	Physiological
V	Trigeminus	Physiological
VI	Abdducens	Right side is impaired
VII	Facialis	Left side is impaired
VIII	Vestibulocochlearis	Physiological
IX	Glossopharyngeal	Physiological
X	Vagus	Physiological
XI	Accesorius	Physiological
XII	Hypoglossal	Physiological

Table 9: Final cranial nerves examinations.

- Examination of cerebellum:
    - Finger-nose attempt: Patient could not perform the test by his left arm. Negative result for the right arm.
    - Finger-finger attempt: Patient could not perform the test by his left arm. Negative result for the right arm.
    - Nystagmus test: Very slightly nystagmus to the right direction.
    - Arm drift test: Patient could not perform the test by his left arm. Negative result for the right arm.

- Proprioceptors examinations:
    - Romberg I: Negative.

- Romberg II: Patient could not perform the test.
- Romberg III: I could not apply the test according to the supervisor instructions.

- Specific neurological test:
  - Paretic test:
    - Mingazzini test upper extremities: Patient could not perform the test.
    - Mingazzini test lower extremities: Negative.
  - Pyramids test:
    - Trömner signs: Negative in both hands.
    - Hoffman test: Negative in both hands.
    - Openheim test: Negative in both legs.
    - Chaddock's Sign: Negative in both legs.
    - Babinski test: Negative in both feet.
- Ashworth scale test for spasticity:

Muscles	Result
Biceps Brachii	1+
Flexor Carpi Ulnaris	2
Flexor Carpi Radials	1+
Flexors Digitorum Profundus	3
Adductor Pollicis	0
Hamstrings	2
Quadriceps	2
Gastrocnemius	1+
Soleus	1+

Table 10: Final Ashworth scale for spasticity.

- Sensation examinations:
    - Upper limb:-
        - Superficial sensation (light touch):-
            - C5 :

              L: Slight decreased and sharp R: Normal
            - C6:

              L: Slight decreased and sharp R: Normal
            - C7:

              L: Slight decreased and sharp R: Normal
            - C8

              L: Slight decreased and sharp R: Normal
            - T1

              L: Slight decreased and sharp R: Normal
            - T2:

              L: Slight decreased and sharp R: Normal
            - T3:

              L: Slight decreased and sharp R: Normal

        - Deep sensation (position):
            - Fingers:

              L: Normal R: Normal
            - Big toe:

              L: Normal R: Normal
            - Other toes:

              L: Normal R: Normal

- Littile toe:

  L: Normal R: Normal

- Deep sensation (pain):
  - C5 :

    L: Normal R: Normal
  - C6:

    L: Normal R: Normal
  - C7:

    L: Normal R: Normal
  - C8

    L: Normal R: Normal
  - T1

    L: Normal R: Normal
  - T2:

    L: Normal R: Normal
  - T3:

    L: Normal R: Normal

- Lower limb:-
  - Superficial sensation (light touch):-
    - L2:

      L: Slightly decreased and sharp R: Normal
    - L3:

      L: Slight decreased and sharp R: Normal

- L4:

  L: Slight decreased and sharp R: Normal

- L5:

  L: Slight decreased and sharp R: Normal

- S1:

  L: Slight decreased and sharp R: Normal

- S2:

  L: Slight decreased and sharp R: Normal

▪ Deep sensation (position):

- 2nd finger:

  L: Normal R: Normal

- 3rd finger:

  L: Normal R: Normal

- Big toe:

  L: Normal R: Normal

- Other toes:

  L: Normal R: Normal

- Littile toe:

  L: Normal R: Normal

▪ Deep sensation (pain):

- L2:

  L: Normal R: Normal

- L3:

  L: Normal R: Normal

- L4:

  L: Normal R: Normal

- L5:

  L: Normal R: Normal

- S1:

  L: Normal R: Normal

- S2:

  L: Normal R: Normal

- Deep tendon reflexes:
  - Biceps C5-C6:

    L: 3 R: 2

  - Triceps C7:

    L: 4 R: 1

  - Flexors C8:

    L: 3 R: 1

  - Patellar L2-L4:

    L: 4 R: 2

  - Achilles L5-S2:

    L: 3 R: 2

- Ankle clonus test: Positive in left leg.

- Abdominal reflexes:
  - T5-T7:

    L: 0 R: 0

- T7-T9:

  L: 0 R: 0

- T9-T11:

  L: 0 R: 0

- T10-T12:

  L: 0 R: 0

3.4.8 ADL Evaluation and Barthel test

The patient could move himself alone from supine to sitting position without therapist also he did not need any assist or any crutch to stand. He still need more time than usual time to wear his T-shirt and his slippers due to the difficulties to abduct and flex the whole arm also the disability to move the ankle joint to the dorsal flexion and aversion but the performance of this activity is much more better than before. He could stand and walk alone with one crutch from the left side. During eating he used his right healthy hand but he could use also his effected hand to hold food. Generally, he still using his right arm for everything he needs to do.

Barthel test:

Activity	Result
Stool incontinence	10
Urinary incontinence	10
Grooming	9
Toilet use	9
Feeding	10
Transfers	9
Walking	7

Dressing	8
Climbing stairs	7
Bathing	9
Sum of results: 88 /100	

Table 11: Final Barthel test.

The conclusion of the Barthel test: According to Barthel index the patient is moderate dependent.

3.4.9 Final Examinations Conclusion

During the Final physical therapy examinations on the 5/1/2016 we found the following findings:

The patient did not have any pain and he was generally happy about his progress but still complaining from the disability of moving the left wrist joint. He is now without urinary catheter since one week ago. Spastic pattern influence his body posture slightly on the left side of the body. The patient could stand without therapist support and with assistive device (one crutch "stick" which has one point in contact with the ground). The whole body was slightly shifted to the right side which influences the pelvis position to lateral tilt (left side). The main results in gait examinations shows that the patient has low stability while walking, no dorsal flexion movement in the patient left foot and the circumduction movement of the whole leg was present when he walks. Lower range of extension movement in both knees more in left knee and left hip joint was observed.

In the direction of extension there was a marked limitation in the range of motion in left distal and proximal interphalangeal joints. Left ankle joint has a moderate limitation to the extension and eversion directions. Slight limitation to the extension direction was in left knee, hip, wrist and shoulder joints.

According to "Ashworth scale" test for the muscles spasticity the highest result was for the fingers joints to the extension direction with a grade of " 3 " and the

grade " 2 " for wrist joint to extension direction, Hamstring muscles and Quadriceps muscles.

From the mental status point of view he was in a good condition. The 6th and 7th cranial nerves we impaired in right and left sides respectively. Slight nystagmus movement was present to the right direction of the right eye. The patient was able to perform the Romberg I test without the using of crutches but he needed one crutch (stick) to perform the Romberg II test. Mingazzini test for upper and lower extremities were positive. Pyramids track examinations show negativity results. The superficial sensation of the upper and lower limbs in the left side of the patient body was slightly low and sharp sensation. He has moderate hyper reflexes in the left side of his body during the deep tendon reflexes test for the Triceps tendon and Patellar tendon also he had a clonus movement in his left leg. Finally, the patient is considered as a moderate dependent patient according to the Barthel scale classification but he scored higher results than the results from the initial examinations.

3.5 Therapy Effect

Generally, due to the differences in patients physical abilities before the stroke and due to the different effects that stroke caused to them the therapy plan and its effect is also different. From the results of the final examinations we found that the therapy was successful in some areas in comparison to the slow prognosis of rehabilitation of this diagnose.

During my work with the patient, I avoid any overloading or overexertion of work and the therapy sessions was to an acceptable level for the patient. The examinations and therapeutic procedures follow principles and methods provided by Kendall et al. (2005), Janda et al. (2013), Kolář et al. (2014) and Kabat with Dis, Petr Smejkal supervising and instructions. In details the negative and positive therapy effects are shown below:

The subjective status presence in the final examinations in comparing to the initial examinations shows that the patient have a night muscles tension (as cramps) in

left side of his body which could be a sign to the spasticity development. The objective point of view of his status presence will be described in details later according to each examination result.

Posture and Gait examinations results shows many positive effects. Gluteus maximus, Hamstrings muscles and Quadriceps femoris muscles were truly effective and I defined those procedures as the most important due to the good result in patient stability during standing and walking. Moreover, I believe that the most effective therapy procedure for my patient which improved his posture and his stability in gait was the daily gait training and DNS exercises (On four position and Modified "on four position") according to Kolář et al. (2014) which improved his deep stabilization muscles system. My patient during the final examinations could stand without the therapist assistance and he could use the normal crutch "one point contact to floor" instead of the four points contact also the width of the support base was decreased. The movement of the trunk was more fluent (swinging to left and right sides) in the final assessment after it was in fix rotation to the left side.

A second positive sign of the therapeutic procedure was the improvement of ROM in all directions of most left body joints. This improvement is due to the active and passive ROM exercises. The following (Table 12) shows the passive ROM examination comparison:

Initial ROM examination	Final ROM examination
Shoulder: S: 40-0-115 F: 45-0-20 T: 50-0-10 R: 70-0-60	Shoulder: S: 40-0-160 F: 90-0-20 T: 90-0-30 R: 80-0-60
Elbow: S: 0-0-145	Elbow: S: 45-45-145

Wrist: S: 40-0-70 F: 20-0-35	Wrist: S: 70-10-80 F: 20-5-40
Forearm: R: 10-90-90	Forearm: R: 70-80-90
Hip: S: 10-0-100 F: 45-0-10 R: 25-0-40	Hip: S: 10-0-125 F: 45-0-10 R: 35-0-45
Knee: S: 0-0-110	Knee: S: 0-0-140
Ankle: S: 15-20-45 R: 5-10-40	Ankle: S: 15-20-45 R: 10-10-40

Table 12: Comparison of initial and final passive ROM results.

Although that Gracies concept for spastic muscles was used in the treatment sessions, unsatisfying result of muscles spasticity test according to Ashworth scale in the final examinations comparing to the initial examinations results was found. I believe that two weeks of working with my patient, from the 4^{th} to 6^{th} weeks after he had the stroke, in the stage that he start to develop spastic pattern according to Thibaut et al. (2013) is not sufficient time to see the effect of the therapy. However, calf muscles were the only muscles that have been affected by our therapy. The following (Table 13) shows the results of both initial and final examinations of the muscles spasticity according to Ashworth scale.

Muscles	Initial Result	Final Result
Biceps brachii	1	1+
Flexor carpi ulnaris	1	2
Flexor Carpi Radials	1+	1+
Flexors Digitorum Profundus	1+	3
Adductor Pollicis	0	0
Hamstrings	1	2
Quadriceps	2	2
Gastrocnemius	2	1+
Soleus	2	1+

Table 13: Comparison of initial and final Ashworth scale test for spasticity results.

However, the patient ability to perform the activities of daily living has been improved to nearly to the degree of "Slight dependent" according to the Barthel scale of measuring the ability of the patient to be completely independent. I refer this improvement to the therapy combination of the PNF strengthening techniques according to Kabat which was applied to the left arm, DNS exercises and strengthening exercises for the lower extremities. The (Table 14) bellow shows the rate of changing in all ADL between the first day and the last day of working with the patient.

Activity	Changing rate
Stool incontinence	0
Urinary incontinence	10 ↑
Grooming	1 ↑
Toilet use	2 ↑
Feeding	0
Transfers	0
Walking	1 ↑
Dressing	3 ↑
Climbing stairs	7 ↑
Bathing	2 ↑

Table 14: Comparison of initial and final Barthel test results.

3.6 Prognosis

The effect of the therapy as it discussed above shows generally good prognosis in comparison to the duration of work with the patient and for the slow rehabilitation progress of this diagnose from the functional point of view. However, me and my patient experience the effect of the therapy and we both were satisfied with the results.

As any rehabilitation prognosis patient has great influence on that starting by the high attitude to improve his situation, following home-exercises, changing his lifestyle and continuing the long rehabilitation program. I believe that the prognosis of my patient will be great and he will improve his functional state from the point of stability, walking and grip if he keeps his high aptitude to be treated in combination with regular self-therapy as he is performing now.

4. Conclusion

The stage that we achieved was a satisfied result for me and for my patient and we could both agree on that the therapy was in the correct path. After each session the patient was happy and motivated, which gives me the feeling that my work and cooperation with him as a therapist were right. Moreover, the support and cooperation that I received during my practice from the physiotherapy staff in the UVN made my work there as a unique experience by that not only the knowledge and skills are the component of successful therapy but communication and cooperation with your colleagues are needed also. I think that all the experiences, which I had during my work, will improve the quality of my career as well as my personal life.

5. BIBLIOGRAPHY

1. Bandi, S., & Ward, A. B. (2010). Spasticity. *International Encyclopedia of Rehabilitation.* Retrieved on February 8, 2016, from http://cirrie.buffalo.edu/encyclopedia/en/article/32/
2. Berry, S. R., Wilson, B. P., Fallon, L. M. (2014). Strokes. *Magill'S Medical Guide (Online Edition).*
3. Brain Basics: Know Your Brain. (2015). *US National Institutes of Health.* Retrieved on February 4, 2016, from http://www.ninds.nih.gov/disorders/brain_basics/know_your_brain.htm
4. Brain. (2016). In *Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/brain
5. Carpenter, R., & Reddi, B. (2012). *Neurophysiology: A Conceptual Approach*. CRC Press.
6. Cerebellum. (2016). *In Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/cerebellum
7. Cerebrum. (2016). *In Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/cerebrum
8. Chisholm, A. E., Perry, S. D., McIlroy, W. E. (2013). Correlations between ankle–foot impairments and dropped foot gait deviations among stroke survivors. *Clinical Biomechanics*, *28*(9), 1049-1054.
9. Cuccurullo, S. J. (2014). *Physical medicine and rehabilitation board review.* Demos Medical Publishing. 411
10. Davis, D. B., Õunpuu, S., DeLuca, P. A., Romness, M. J. (1999). Clinical gait analysis and its role in treatment decision-making. *Medscape General Medicine, 1*(1). From: http://www.medscape.com/viewarticle/440148_5
11. Epidemiology of Stroke. (2016). *European Stroke Organisation.* Retrieved on February 6, 2016, from http://www.eso-stroke.org/eso-stroke/stroke-information/faq/epidemiology-of-stroke.html

12. Forebrain. (2016). In *Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/forebrain

13. Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Blaha, M. J., Fullerton, H. J. (2014). Heart disease and stroke statistics-2014 update. *Circulation*, *129*(3).

14. Gracies, J. M. (2001). Pathophysiology of impairment in patients with spasticity and use of stretch as a treatment of spastic hypertonia. *Physical medicine and rehabilitation clinics of North America*, *12*(4), 747-68.

15. Gracies, J. M. (2015). The Concept of Guided Self-Rehabilitation Contracts in the Treatment of Deforming Spastic Paresis. *Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin*, *25*(03), IS26.

16. Hindbrain. (2016). In *Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/hindbrain

17. James, K. (2016). Cerebellum. *Neuroscience online*. Retrieved on February 4, 2016, from http://neuroscience.uth.tmc.edu/s3/chapter05.html

18. Janda, V. (2013). *Muscle function testing.* Elsevier.

19. Kendall, F. (2005). Muscles: Testing and function with posture and pain (5th ed). Baltimore, MD: Lippincott Williams & Wilkins.

20. Kernan, W. N., Ovbiagele, B., Black, H. R., Bravata, D. M., Chimowitz, M. I., Ezekowitz, M. D., Johnston, S. C. C. (2014). Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *45*(7), 2160-2236.

21. Khoury, J. C., Kissela, B., Sucharew, H., Alwell, K., Moomaw, C., Woo, D., Broderick, J. (2013). Is the Rate of Ischemic Stroke Incidence Changing Differentially Over Time for Women and Men?. *Stroke*, *44*(Suppl 1), A145-A145.

22. Lee, B., Heidi B. (2013). Proprioceptive Neuromuscular Facilitation: The Foundation of Functional Training. *Functional Movement.* Retrieved on February 6, 2016, from http://www.functionalmovement.com/articles/Screening/2013-07-

04_proprioceptive_neuromuscular_facilitation_the_foundation_of_functional_training

23. Leung, J., Smith, R., Harvey, L. A., Moseley, A. M., Chapparo, J. (2014). The impact of simulated ankle plantarflexion contracture on the knee joint during stance phase of gait: A within-subject study. *Clinical Biomechanics*, *29*(4), 423-428.

24. Michael, R. L., Samuel R. B. (2015). Spasticity: Classification, Diagnosis, and Management. *Clinical Gate.* Retrieved on February 6, 2016, from http://clinicalgate.com/spasticity-classification-diagnosis-and-management

25. Midbrain. (2016). In *Encyclopædia Britannica*. Retrieved on February 4, 2016, from http://www.britannica.com/science/midbrain

26. Neurons (Nerve Cells). (2016). *PubMed Health.* Retrieved on February 4, 2016, from http://www.ncbi.nlm.nih.gov/pubmedhealth/PMHT0024269/

27. Patel, A. T. (2010). Early Diagnosis of Post-stroke Spasticity and Treatment Options. *Touch Neurology*, *5*(2), 47-51. Retrieved on February 8, 2016, from http://www.touchneurology.com/articles/early-diagnosis-post-stroke-spasticity-and-treatment-options

28. Post-Stroke Conditions. (2016). *National Stroke Association.* Retrieved on February 8, 2016, from http://www.stroke.org/we-can-help/survivors/stroke-recovery/post-stroke-conditions/physical

29. Purves, D., Augustine, G. J., Fitzpatrick, D., Katz, L. C., Lamantia, A. S., McNamara, J. O., Williams, S. M. (2001). *Neuroscience. 2nd.* Sunderland. MA: Sinauer Associates.

30. Rebecca, J., Stahl, M. (2015). Cerebellar Stroke. *CVS*. Retrieved on February 4, 2016, from http://health.cvs.com/GetContent.aspx?token=f75979d3-9c7c-4b16-af56-3e122a3f19e3&chunkiid=644493

31. Singer, M. L., Kobayashi, T., Lincoln, L. S., Orendurff, M. S., Foreman, K. B. (2014). The effect of ankle–foot orthosis plantarflexion stiffness on ankle and knee joint kinematics and kinetics during first and second rockers of gait in individuals with stroke. *Clinical Biomechanics*, *29*(9), 1077-1080.

32. Sommerfeld, D. K., Eek, E. U. B., Svensson, A. K., Holmqvist, L. W., Arbin, M. H. (2004). Spasticity after stroke its occurrence and association with motor impairments and activity limitations. *Stroke*, *35*(1), 134-139

33. Stephen, H., Helmi, L. (2014). Cerebellar Hemorrhage Clinical Presentation. *Medscape.* Retrieved on February 6, 2016, from http://emedicine.medscape.com/article/1163554-clinical#showall

34. Strizhak, A. (2014). Stroke. *Neurological Disorders - All You Need to Know.* Retrieved on February 6, 2016, from https://www.doctorstrizhak.com/lacunar_stroke.php

35. Thibaut, A., Chatelle, C., Ziegler, E., Bruno, M. A., Laureys, S., Gosseries, O. (2013). Spasticity after stroke: physiology, assessment and treatment. *Brain Injury*, *27*(10), 1093-1105.

36. Tonya, H. (2013). Anatomy of the Brain. *Mayfield Certified Health Info.* Retrieved on February 4, 2016, from http://www.mayfieldclinic.com/PE-AnatBrain.htm

37. Ward, A., Jost, W., Jech, R., Gracies, J. M. (2016). Comprehensive Care of Patients with Spastic Paresis – A Long-Term Commitment. *Touch Neurology*. Retrieved on February 8, 2016, from http://www.touchneurology.com/articles/comprehensive-care-patients-spastic-paresis-long-term-commitment

38. Wright, L., Hill, K. M., Bernhardt, J., Lindley, R., Ada, L., Bajorek, B. V., Hersh, D. (2012). Stroke management: updated recommendations for treatment along the care continuum. *Internal medicine journal*, *42*(5), 562-569.

39. Zhang, Y., Chapman, A. M., Plested, M., Jackson, D., Purroy, F. (2012). The incidence, prevalence, and mortality of stroke in France, Germany, Italy, Spain, the UK, and the US: a literature review. *Stroke research and treatment*, *2012*.

6. SUPPLEMENTS

Supplement 1

List of tables

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List of abbreviations

UVN → Ústřední vojenská nemocnice.

ROM → Range of motion.

ADL → Activity of daily living.

CNS → Central Nerve System.

RR → Relative risk.

INR → International normalized ratio.

CT → Computer tomography.

MRI → Magnetic resonance imaging.

PNF → Proprioceptive neuromuscular facilitation.

US → United State.

tPA → Tissue plasminogen activator.

ASA → American Stroke Association.

FRC → Frixiparin.

DD → Diadynamic currents.

ABD → Abduction.

ER → External rotation.

TE → Thromboembolism.

DNS → Dynamic neuromuscular stabilization.

Supplement 4

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na[1] ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem[2] ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele .....
Podpis:.....

Jméno a příjmení osoby, která provedla poučení[3].....
Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....

Jméno a příjmení pacienta ..... Podpis pacienta: .....

Jméno a příjmení zákonného zástupce[4] .....….

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

Supplement 5

Ethics committee approval form

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

The title of a project: Physiotherapeutic case study of hemorrhagic stroke in cerebellum with hemiplegia patient

Project form: bachelor
Period of realization of the project: January 2016
Applicant: Faisal Alharthi
Main researcher: Faisal Alharthi
Co-researcher(s):
Supervisor (in case of student's work): Petr Smejkal
Financial support:

Project description: My project is about a patient with hemorrhagic stroke with hemiplegia (left side). He is in semi-acute inpatient department in (ÚVN) hospital Praha 6.

Applied procedures: initial kinesiological examinations and therapy with my supervisor according to his instructions and according to the hospital protocol which recommend the (Gracias concept) for therapy which contains progressive stretching, repetitive movements passively then active movements; application of gait training; final kinesiological examinations.

Ensuring safety within the research: No invasive methods with the patient are used. Supervision is provided by the supervisor. All methods are according to the hospital protocol.

Ethical aspects of the research: The participant is adult and he is non-vulnerable. All his personal data will be anonymised and preserved in anonymity.

Informed Consent: attached

It is a duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

I confirm that this project description corresponds to the plan of the project and in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 18/1/2016 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.
Members: prof. PhDr. Pavel Slepička, DrSc.
doc. MUDr. Jan Heller, CSc.
doc. Ing. Monika Šorfová, Ph.D.
Mgr. Pavel Hrásky, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 029/2016

Date of approval: 19.1.2016

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

Stamp of UK FTVS UNIVERZITA KARLOVA v Praze Fakulta telesne vychovy a sportu Jose Martiho 31, 162 52, Praha 6

Signature of the Chair of UK FTVS Ethics Committee